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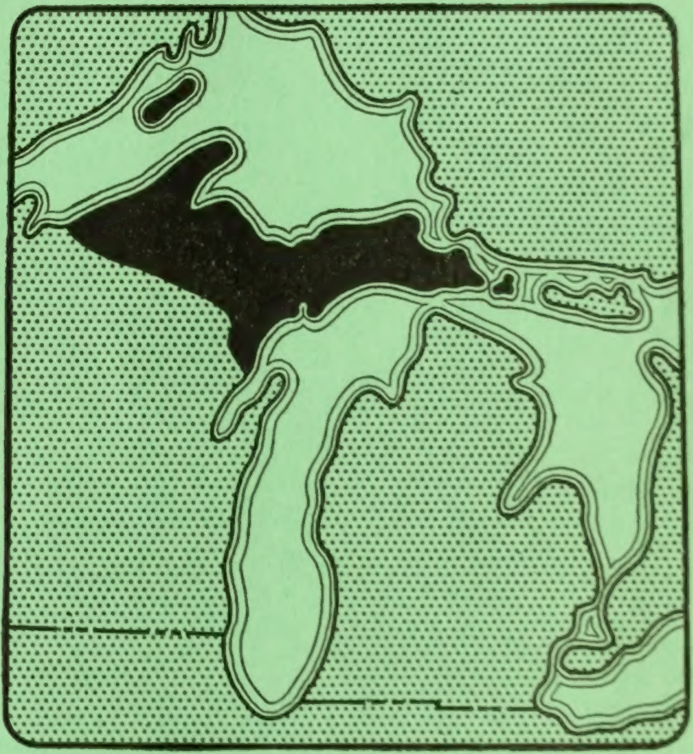

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Forest Resources of the Upper Peninsula of Michigan

* * *

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LAKE STATES FOREST EXPERIMENT STATION

FOREST SERVICE

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The Forest Survey

BECAUSE the forest problem is essentially one of land use and a part of the larger problem of agriculture and because forests are intimately tied into our whole social and economic life, an inventory of forests and an analysis of our needs for forest products are basic to permanent forest production and national welfare. It is estimated that forests grow on one-third of the land area of this country but neither this fact nor the condition or volume of timber of the land has ever been established by field investigation. To bridge this gap Congress authorized the Secretary of Agriculture through the McSweeney-McNary Forest Research Act of May 22, 1928, to conduct a comprehensive survey of the forest resources of the United States, now called the Nation-wide forest survey.

The Forest Survey, as constituted under that act, is obtaining essential field information and, through interpretation thereof, is aiding in the formulation of guiding principles and policies fundamental to a system of planned management and forest-land use for each forest region and for the Nation.

The fivefold purpose of the Forest Survey is: (1) To make a field inventory of the present supply of timber and other forest products; (2) to ascertain the rate at which this supply is being increased through growth; (3) to determine the rate at which it is being diminished through industrial and domestic uses, windfall, fire, disease, and other causes; (4) to determine the present consumption of timber and other forest products and the probable future trend in requirements; and (5) to interpret these findings and correlate them with existing and anticipated economic conditions, to aid in formulating both private and public policies for the effective and rational use of land suitable for forest production.

It is planned to publish the results of this investigation as they become available. These publications apply to large areas and should not be interpreted as portraying correctly the forest situation for small sections, the condition of which may be either better or poorer than the average for the entire unit. They supply the general framework upon which to base intensive studies of critical situations.

The investigation is conducted in the various forest regions by the forest experiment stations of the Forest Service, and in the Lake States by the Lake States Forest Experiment Station with headquarters in St. Paul, Minn.

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Introduction

The Nature of the Survey

LAND and timber in northern Michigan were inventoried by the Lake States Forest Experiment Station[1] in 1935–36. Lines were run east and west, 10 miles apart, on which 0.2-acre sample plots were measured at 10-chain intervals. This mechanical sample of about 13,000 plots gave very accurate results for a 5-million-acre unit but could not portray correctly the forest situation in single counties or smaller subdivisions. It supplied the general framework upon which to base intensive studies of critical situations.

Growth forecasts were based upon yield tables, with allowance for the approach of understocked stands toward full stocking. Special yield tables were prepared to conform to Forest Survey volume tables and standards of merchantability. Estimates of growth in selectively logged hardwood forests were based upon sample-plot records at the Upper Peninsula Experimental Forest maintained by the Lake States Forest Experiment Station at Dukes, Mich.

As a basis for drain estimates and to provide figures for an analysis of the industrial situation, a complete canvass of wood-using industries was made in 1935. The larger units were contacted again in 1937 and 1938. Domestic use was surveyed on sample farms and in a number of villages and cities. Wood consumption in mines, railroads, docks, etc., was obtained in special studies. Fire losses were based upon a 10-year record of the State Conservation Department. An annual drain of 0.25 percent was allowed for other losses.

The raw-wood requirements of most industries were obtained in conjunction with the drain survey. Since the Upper Peninsula is an exporting rather than a lumber-consuming region, no consideration was given to the consumption of lumber and other finished products in the area itself.

The most important economic factor which must be considered in analyzing the Upper Peninsula situation is ownership of land and timber. The estimates for large private owners were obtained from company records. National-forest estimates were based upon intensive land-acquisition surveys. The estimates for State land and small private owners were based upon the samples obtained on the 10-mile lines. Since ownership is changing quite rapidly, these estimates are not exact for the present time; but they are believed to be sufficiently accurate to picture the general situation.

The field inventory in Michigan was under the direction of E. L. Lawson. C. H. Stoddard, Jr., and C. J. Holcomb collected most of the data on forest industries and depletion. S. R. Gevorkiantz and Wm. A. Duerr supervised the growth calculations. Gevorkiantz and E. I. Roe assisted in the preparation of the type map. J. M. Walley, S. D. Anderson, and C. B. Stott of the Regional Office of the Forest Service, Milwaukee, contributed valuable data on condition of individual operating companies.[2] This report bears on all phases of the work except that of requirements, which will be treated in separate reports.

The Findings in Brief

In view of the multiplicity of data presented in the following pages, a brief summary of the salient facts may be helpful at this point. The figures given are in most cases approximations; for more detailed figures and major break-downs of these statistics, see the tabulations in the following text and in the Appendix, page 27.

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[1] Maintained by the Forest Service at University Farm, St. Paul, Minn., in cooperation with the University of Minnesota.

[2] Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration, Official Project 665–71–3–69—sponsor, University of Minnesota; and O. P. 01–2–71–126—sponsor, Lake States Forest Experiment Station.

Forest industries and associated woods activities:

Number of industries	280
Part-time employment (men)	32, 000
Invested capital	$120,000, 000

Forests areas:

The Upper Peninsula has more saw-timber area than any other unit of comparable size in the Lake States.

	Acres
Saw timber	2, 412, 000
Cordwood	1, 727, 000
Restocking	3, 993, 000
Deforested	1, 204, 000
Total (nearly 90 percent of land area)	9, 336, 000

Timber volume:

Saw timber—40 percent of the Lake States total (M board feet)	23, 000, 000
High-grade pulpwood (cords)	11, 000, 000
Chemical wood (cords)	27, 000, 000
White-cedar poles (pieces)	21, 000, 000

Annual increment (growth minus normal mortality):

Saw timber (board feet)	344, 000, 000
All wood (cubic feet)	161, 000, 000

Timber cut and destroyed annually:

Saw timber (board feet)	758, 000, 000
All wood (cubic feet)	247, 000, 000

At this rate, the remaining merchantable timber will disappear in 25 to 30 years.

Allowable drain with good management:	*Board feet*
Immediately	589, 000, 000
Eventually	1, 000, 000, 000

Ownership:

Public agencies own one-fourth of the land but only 6 percent of the saw timber. The most critical problems are on private lands.

Explanation of Terms Used

The following definitions of technical and unusual terms used in this report are given to facilitate a thorough understanding of the forest situation here discussed.

AREAS

Forest Land.—All wooded areas and the intermingled open areas obviously suitable for timber production and not devoted to other uses. Marshes, bogs, rock outcrops, beaches, small lakes, etc., were not included. Woodlands within city parks or inside platted districts were also omitted.

Old-growth Saw-timber Areas.—Lands with at least 2,000 board feet of merchantable saw timber per acre, mostly in trees 15 inches d. b. h.[3]

Second-growth Saw-timber Areas.—Lands with at least 2,000 board feet of merchantable saw timber per acre, mostly in trees 10, 12, and 14 inches d. b. h.

Cordwood Areas.—Lands with at least 3 cords of small merchantable wood per acre, mostly in trees 6 and 8 inches d. b. h.

Restocking Areas.—Lands with at least 10 percent of the surface area occupied by trees of commercial species, mainly seedlings and saplings up to cordwood size (5 inches d. b. h.). Restocking areas of medium to good density are those with 40 percent or more of the surface occupied. Those of poor density are the ones with 10 to 40 percent of the surface occupied.

Deforested Areas.—Previously timbered lands which now have less than 2,000 board feet of saw timber or 3 cords of cordwood, or not enough reproduction to be considered 10 percent stocked. Many lightly-wooded pastures, where most of the large trees are unmerchantable and the reproduction is killed back by livestock, come within this classification.

COVER TYPES [4]

Jack Pine.—Associations in which jack pine predominates, or, in other words, attains 50 percent or more of the sawlog volume in old-growth or second-growth saw timber, 50 percent or more of the cordwood volume in cordwood stands, or 50 percent or more of the small trees on restocking areas.

Red Pine.—Associations in which red pine similarly predominates.

White Pine.—Associations in which eastern white pine predominates.

Northern Hardwoods.—A mixed type in which the principal species are sugar maple, eastern hemlock, American beech, yellow birch, and American basswood. Associated species are eastern white pine, oaks, balsam fir, eastern hophornbeam, elms, and white-cedar. The composition varies from a mixture of all species to an almost pure stand of any one of the key species.

Aspen-Birch.—Quaking aspen and paper birch, either singly or together, make up 50 percent or more of the stand.

Ash-Elm.—This type occurs in shallow swamps, on overflow lands, or on "second bottoms," the characteristic species being black ash, American elm, and soft maples.

Spruce-Fir.—This type is characteristically a mixture of white spruce, balsam fir, eastern white-cedar, eastern hemlock, paper birch, quaking aspen, and black ash. It occurs on cool, moist uplands, or along swamp borders.

Spruce Swamp.—Closely confined to acid peat bogs with poor drainage and thus distinguished from the spruce-fir type, which grows on upland soils. Black spruce may occur in pure stands or mixed with balsam fir, tamarack, and white-cedar.

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[3] D. b. h. = diameter at breast height, or 4.5 feet.

[4] Accepted common and botanical names of all cover species mentioned in this publication are given on p. VIII.

Tamarack Swamp.—Very similar to the spruce-swamp type in characteristic associates and site, tamarack predominating.

"Cedar" [5] *Swamp.*—Occurring on shallow peat, having fair drainage, the common associates being the spruces, balsam fir, tamarack, and paper birch. (A mixture of white-cedar and other conifers on upland sites was classified under the spruce-fir type.)

Nonproductive Swamp.—Scrubby spruces or tamarack on deep, poorly drained peat, usually less than 5 inches d. b. h. at 100 years of age. This type does not include peat lands that are deforested but potentially productive.

Scrub Forest.—Stands of any species or mixture that are of such poor form as to be totally unmerchantable except for fuel wood and show no promise of becoming merchantable.

VOLUMES

Merchantable Timber.—Timber of the size and quality usually accepted in commercial operations. It does not have an economic meaning such as saleable or accessible.

Saw-timber Volume.—Saw-timber or board-foot volume is recorded by International (¼-inch kerf) scale, which closely approximates the green-chain tally of the logs. Board-foot volume was estimated for all trees in the 10-inch diameter class (9.0–10.9 inches d. b. h.) or higher containing at least one 10-foot log of good quality or a 16-foot log of poor quality. Minimum top diameter for sawlogs was 6 inches d. i. b.[6] for softwoods and aspen; 8 inches for other hardwoods. For most trees the top diameter was greater than 8 inches because of the limitation of merchantability.

Cordwood Volume.—Cords were compiled on the basis of 75 cubic feet of wood per cord, which, for the average size and shape of cordwood, will make a stack of standard size, 4 by 4 by 8 feet, when piled with bark on.

High-grade Pulpwood.—The pulpwood volume estimates included wood in trees below saw-timber size from which at least two 8-foot sticks could be cut and in tops of sawlog trees from which at least one 8-foot stick could be cut. A few small logs of pulpwood species were also estimated as pulpwood rather than sawlogs. In the case of aspen and hemlock, no wood smaller than 5 inches d. i. b. was estimated as pulpwood. For other species the minimum diameter was 4 inches.

"Cedar" Products.—White-cedar was estimated in terms of poles and posts. The standards for poles conformed to the specifications of the Northern White Cedar Association; lengths ranged from 16 feet to 45 feet, and minimum and maximum top diameters varied with the length of the pole, from 4.5 to 9 inches. White-cedar posts were 7 feet long, with a minimum top diameter of 4 inches.

Total Volume.—Total volume is expressed in cubic feet of wood (excluding bark). It includes the volume between stump and a 4-inch top. In the case of hardwoods it includes the volume of large limbs to a 4-inch minimum diameter.

LOG GRADES

Hardwood saw timber was graded according to the following specifications:

No. 1 Logs.—At least 12 feet long and 12 inches d. i. b. at the small end, the following defects being allowed, the variation depending on log diameter: Up to three standard defects or sound bright knots, each with a diameter of not more than 3 inches, or their equivalent in damage to the product of the log; up to 20 percent deduction from the gross scale for rot or similar defects. No. 1 logs were expected to saw out 60 percent or more of No. 1 common or better lumber.

No. 2 Logs.—Generally at least 10 feet long and 8 inches d. i. b. at the small end, including, however, the better-quality 8-foot logs, 10 inches d. b. h. or more; but these—and likewise all longer logs less than 10 inches d. i. b.—to be surface clear, straight, and sound. Logs more than 10 inches d. b. h. were permitted as many as three standard defects. No. 2 logs were expected to saw out 75 percent sound lumber, of which 30 percent would be No. 1 common or better.

No. 3 Logs.—Including all logs suitable for ties, timbers, or low-grade lumber. For most species the minimum size requirements were 8-foot length and 8-inch diameter. These logs would generally saw out 50 percent sound.

Cull.—Culls included large trees (18 inches d. b. h. or more) which did not contain one 16-foot No. 1 or No. 2 grade log, or two 16-foot No. 3 grade logs; smaller sawlog-size trees (10 to 16 inches in diameter), if they did not contain one 10-foot No. 2 log or one 16-foot No. 3 log; defective small trees; white-cedar trees, too crooked or decayed to produce at least one 16-foot pole or two 7-foot posts. Also deductions were made in the volume of merchantable sawlog trees for rot, crook, fork, shake, and other defects.

GROWTH AND YIELD

Current Annual Growth.—Current annual growth figures purport to show what the present forest areas are likely to produce annually during the decade 1935–44, if no radical changes occur in their acreage or composition. Technically, this is known as periodic annual growth.

Allowable Annual Drain.—Allowable annual drain is the average volume of mature merchantable timber that will be ready for cutting each year during the next few decades under a conservative form of management. In old-growth slow-growing stands, the allowable drain exceeds annual growth, but in young stands it is less because most of the growth there is on immature trees.

Normal Actual Drain.—The term "normal actual drain" refers to prospective use of wood during the next decade, providing general economic conditions are reasonably stable. It is based upon a compilation of estimates of individual operators, reinforced in some places by actual averages for the preceding 5 or 10 years. Where actual production or consumption figures are presented in connection with normal drain estimates, the year to which they apply is indicated.

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[5] Northern white-cedar (*Thuja occidentalis*) is not a true cedar (*Cedrus*) and "cedar" is therefore a misnomer for this species, although in common usage.

[6] D. i. b. = diameter inside bark.

OWNERSHIP

National Forest.—Lands owned by the Federal Government within established forests or purchase units and lands optioned and approved for purchase by the National Forest Reservation Commission.

Indian.—Tribal lands and trust allotments—not lands allotted in fee.

Other Federal.—Lands under the control of the Park Service, Bureau of Biological Survey, United States Army, and General Land Office.

State.—Congressional grants, areas purchased or received as gifts, and lands which have reverted to the State for nonpayment of taxes.

County and Municipal.—Any forest lands owned by the counties, cities, or villages outside of platted districts.

Farm Woods.—Woodlands within farms as defined by the Census Bureau.

Industrial and Other.—All privately owned forest lands outside of farms.

Common and Scientific Names of Species Mentioned

COMMERCIAL SPECIES

Ash, black	*Fraxinus nigra*
Ash, green	*F. pennsylvanica lanceolata*
Ash, white	*F. americana*
Aspen, bigtooth	*Populus grandidentata*
Aspen, quaking	*P. tremuloides*
Basswood, American	*Tilia glabra*
Beech, American	*Fagus grandifolia*
Birch, paper	*Betula papyrifera*
Birch, yellow	*B. lutea*
Boxelder	*Acer negundo*
Cherry, black	*Prunus serotina*
Elm, American	*Ulmus americana*
Elm, rock	*U. thomasii* (Sarg.)
Elm, slippery	*U. fulva*
Fir, balsam	*Abies balsamea*
Hemlock, eastern	*Tsuga canadensis*
Hophornbeam, eastern	*Ostrya virginiana*
Maple, red	*Acer rubrum*
Maple, silver	*A. saccharinum*
Maple, sugar	*A. saccharum*
Oak, bur	*Quercus macrocarpa*
Oak, northern pin	*Q. ellipsoidalis*
Oak, northern red	*Q. borealis*
Oak, swamp white	*Q. bicolor*
Oak, white	*Q. alba*
Pine, eastern white	*Pinus strobus*
Pine, jack	*P. banksiana*
Pine, red	*P. resinosa*
Poplar, balsam	*Populus balsamifera*
Spruce, black	*Picea mariana*
Spruce, white	*P. glauca*
Tamarack	*Larix laricina*
White-cedar, northern	*Thuja occidentalis*
Willow	*Salix* spp.

NONCOMMERCIAL SPECIES

Alder, speckled	*Alnus incana*
Cherry, pin	*Prunus pennsylvanicum*
Hawthorn	*Crataegus* spp.
Hornbeam, American	*Carpinus caroliniana*
Maple, mountain	*Acer spicatum*
Maple, striped	*A. pennsylvanica*
Mountainash, American	*Sorbus americana*
Plum, American	*Prunus americana*

The Economic Background

Land Use

A little over 10½ million acres, or 29 percent of the land area of Michigan, is included in the Upper Peninsula—the northern division which is separated from the rest of Michigan by two of the Great Lakes—and of this area about 88 percent is forested (table 1). The western half of the Peninsula, including Marquette and Dickinson Counties and the counties to the west of these, is more heavily timbered than the eastern half.

TABLE 1.—*General classification of land in the Upper Peninsula of Michigan*

Class of land	Area	
	Acres	*Percent*
Nonforest land:		
Improved farm [1]	683,000	6.5
Urban	28,000	.3
Rights-of-way	116,000	1.1
Miscellaneous industrial	90,000	.8
Open bog and marsh	120,000	1.1
Other unused open land	97,000	.9
Unsurveyed waters	101,000	1.0
Total	1,235,000	11.7
Forest land	9,336,000	88.3
Total land area	10,571,000	100.0

[1] This acreage slightly exceeds the Census Bureau estimate of cropland and plowable and other except woodland pasture, probably because farmsteads and certain wild meadows used for pasture were included.

The Great Lakes cut-over region, of which the Upper Peninsula is a part, has been referred to as one of the critical problem areas of the United States,[7] characterized by depleted natural resources, scattered and illogical settlement, serious unemployment, overly complicated government, and high taxes with consequent extensive tax delinquency. The Upper Peninsula shares these difficulties to a considerable extent but has to its credit on the other side of the ledger a large volume of as yet unexploited virgin timber.

The People and Employment

The population of the Upper Peninsula in 1930 was 318,676 or 19.1 persons per square mile. This is about average density for the cut-over region of the Lake States but contrasts markedly with the average density in the Lower Peninsula of Michigan of 110.9 persons per square mile. With 29 percent of the land area, the Upper Peninsula included less than 7 percent of the State's population. Population increased 2.1 percent between 1910 and 1920, but declined 4.2 percent between 1920 and 1930.

Nearly one-fourth (22.6 percent) of the 1930 population of the Upper Peninsula was foreign-born and nearly half (47.4 percent) had one or both parents of foreign birth. There are 23 distinct Finnish settlements, 10 French, 9 Swedish, 5 German, 3 Polish, 2 Belgian, 2 Indian, and 1 each of Danes, Scots, Irish, Russians, Dutch, and Italians. Fortunately, most of these people have a certain common background and tradition of soil and forest conservation, and with suitable leadership can readily adjust themselves to a program of proper land use. A wide variety of occupations is recorded in the 1930 census, but most jobs tie directly or indirectly to farming, mining, and forestry.

Relief authorities report that, in December 1934, 105,246 persons, or one-third of the total population, were dependent upon relief. In this group less than half (47,760) were employable persons unable to obtain work. Of all those on relief, the greatest number were in the more heavily timbered western half of the Peninsula, where 79,240 out of 204,608 total population were receiving aid. In Iron County (April 1934) 43 percent of the total population of 20,805 was receiving help. The relief load decreased about one-third by 1937, but has shown no tendency to decrease further. Whether there is a possibility of absorbing the greater part of these relief cases through better farming, forestry, and other regular jobs is one of the primary concerns of planning agencies in Michigan today.

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[7] [UNITED STATES] NATIONAL RESOURCES COMMITTEE. REGIONAL PLANNING. PART VIII—NORTHERN LAKE STATES. 63 pp., illus. Washington [D. C.] 1939.

Agricultural Possibilities

According to the 1935 Agricultural Census there are 16,081 farms in the Upper Peninsula. This number is 2,994 greater than in 1930 and 3,764 greater than in 1920. The average farm contains 90 acres, including 31 acres of cropland, 41 acres of woods, and 18 acres of other land. Thus, only 13.7 percent of the land area of the Peninsula is in farms.

Distance from markets, a short growing season, and scarcity of first-class agricultural soils place limits on the possibilities of the area for commercial-farming development. No doubt many of the present partially developed farms by additional clearing and better selection of crops can be made more self-sufficient, and some new units can be established; but development of this kind must necessarily be slow.

Supplementing farming with other occupations offers greater possibilities for expansion, provided sufficient outside work can be found. More than half of the farmers obtained a part of their income from outside work in 1935, according to the Agricultural Census. Mixed farming and forestry is natural for many of the nationality groups in the Upper Peninsula, while others are accustomed to working in the mines during parts of the year. Road work, trucking, running a store or cabin camp, guiding fishermen, and other part-time jobs are available to many settlers.

To permit appreciable expansion in part-time farming, however, a degree of permanence must be secured in the other basic industries of the region, such as mining and forestry.

Logging and Forest Industries

Although large-scale lumbering has declined greatly in recent years, it is probable that almost as many men are employed now in forest activities as when pine logging was at its height. Many small industries have come in, and work on public forests has expanded greatly.

According to the mill-to-mill canvass made by the Forest Survey (summarized in table 2), more than 3 million man-days of employment in woods work is provided by the lumbering and other forest industries and in the preparation of rough forest products. Public agencies normally employ from

TABLE 2.—*Production and employment in forest industries in Upper Peninsula of Michigan, 1934*

Industry or product	Production[1]		Normal annual employment in—		Mills reporting
	Actual	Normal annual	Woods[2]	Mill	
Industry:	*M board feet*	*M board feet*	*1,000 man-days*	*1,000 man-days*	*Number*
Sawmills	217,100	380,700	581	718	221
Veneer mills	2,000	4,200	9	27	3
Wooden-container mills[3]	7,100	9,800	20	72	4
Miscellaneous wooden-product industries[4]	10,500	21,500	43	124	3
	Cords	*Cords*			
Hardwood distillation	109,500	250,000	250	221	5
Pulp mills	158,000	178,000	250	195	5
	1,000 pieces	*1,000 pieces*			
Lath mills[5]	3,300	10,000	--------	5	22
Shingle mills	13,600	40,600	10	20	17
Total	--------	--------	1,163	1,382	280
Rough products:	*M board feet*	*M board feet*			
Mine timbers	23,400	44,900	90	--------	--------
Piling	600	600	2	--------	--------
Cabin poles	1,700	1,700	4	--------	--------
	Cords	*Cords*			
Mine poles and lagging	12,900	24,900	18	--------	--------
Fuel wood	712,400	712,400	1,069	--------	--------
Miscellaneous cordwood[6]	3,500	3,500	7	--------	--------
	1,000 pieces	*1,000 pieces*			
Hewed ties	191	265	26	--------	--------
Poles	142	314	47	--------	--------
Posts	3	4	100	--------	--------
Logs shipped out:	*M board feet*	*M board feet*			
Sawlogs	14,300	14,300	29	--------	--------
Veneer logs	1,700	8,800	22	--------	--------
Other logs[7]	7,900	8,600	17	--------	--------
	Cords	*Cords*			
Pulpwood	306,400	323,500	485	--------	--------
Excelsior bolts	10,200	10,600	16	--------	--------
Total	--------	--------	1,932	--------	--------
All products	--------	--------	3,095	1,382	280

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[1] Consumption rather than production figures are given for veneer, wooden-container, distillation, pulp, and miscellaneous industries.

[2] Figures are based on average rates of woods employment (including employment in transportation) per unit of product.

[3] Berry boxes, cheese boxes, and other veneer containers.

[4] Handles, bowls, clothespins, brush backs, etc.

[5] Estimated on basis of partial reports and Bureau of the Census records.

[6] Rough bridge material, car stakes, etc.

[7] For wooden-container mills and miscellaneous wooden-product industries.

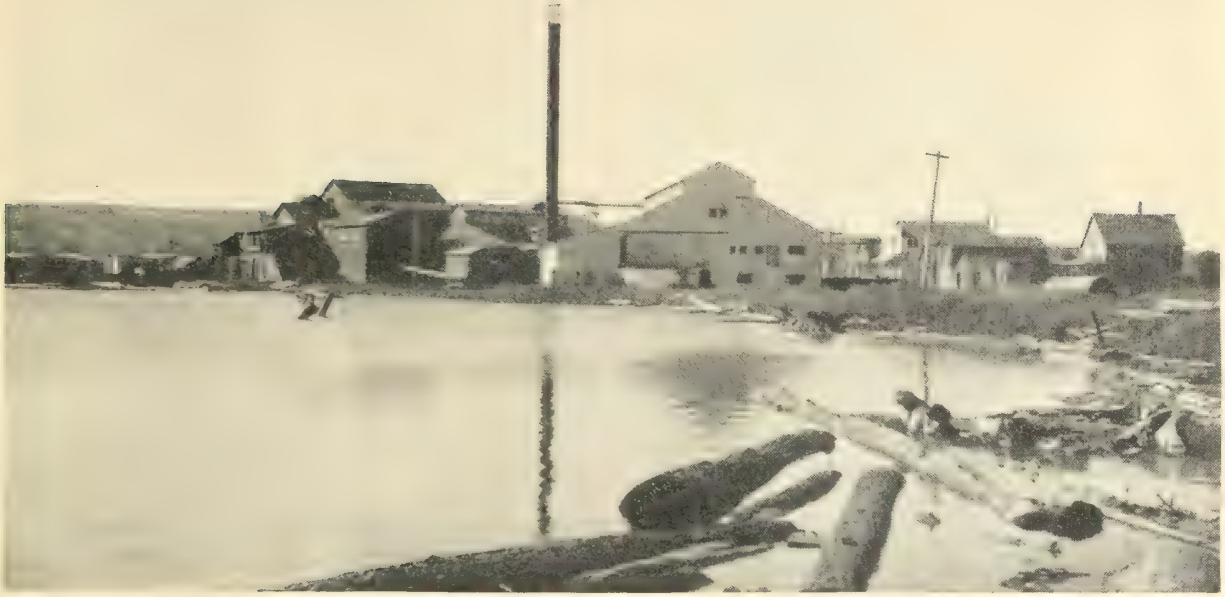

Figure 1.—*One of the medium-sized sawmills in the Upper Peninsula. Daily capacity about 35 thousand board feet; annual output 10 to 12 million feet.*

100 to 500 men to supervise the National and State forests and for general fire protection. As many as 5,000 or 6,000 have been employed recently in the Civilian Conservation Corps camps and on forestry work under the Civil Works Administration, Emergency Relief Administration, and Works Progress Administration.

The area of virgin forest yet remaining in the Upper Peninsula, according to the survey inventory, contains more than half the hemlock, sugar maple, and yellow birch remaining in the entire Lake States region; but the conditions which have favored preservation of standing timber in northern Michigan have undergone changes in recent years and can no longer be relied upon to safeguard this important resource. For one thing, this region

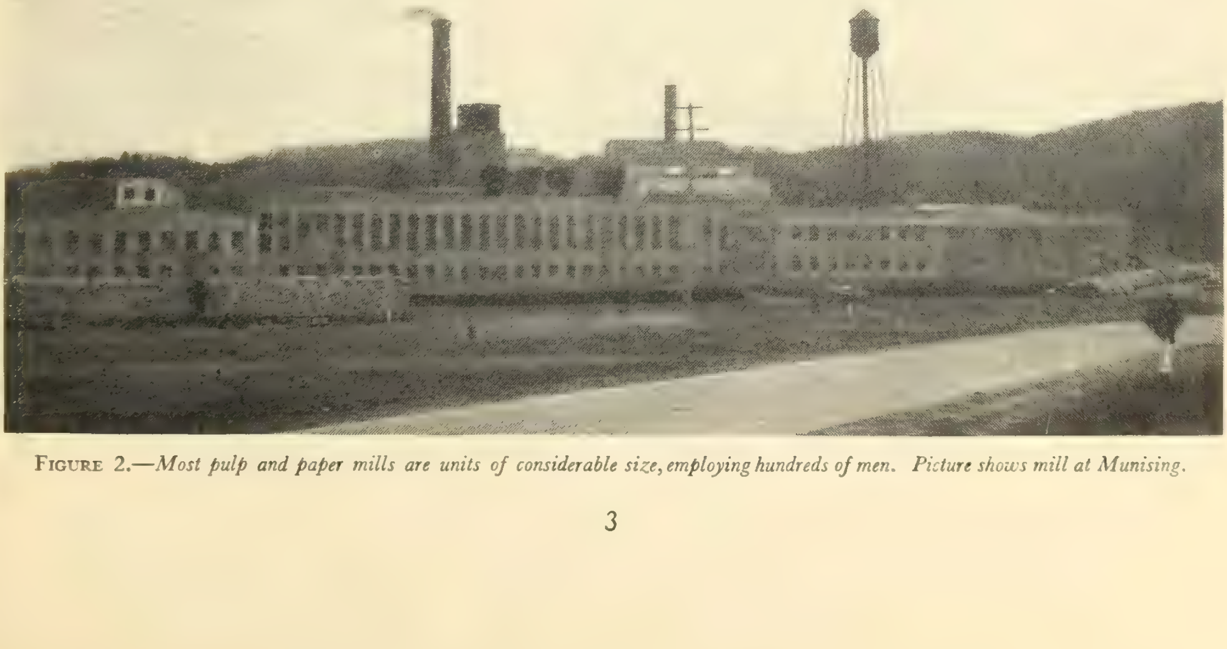

Figure 2.—*Most pulp and paper mills are units of considerable size, employing hundreds of men. Picture shows mill at Munising.*

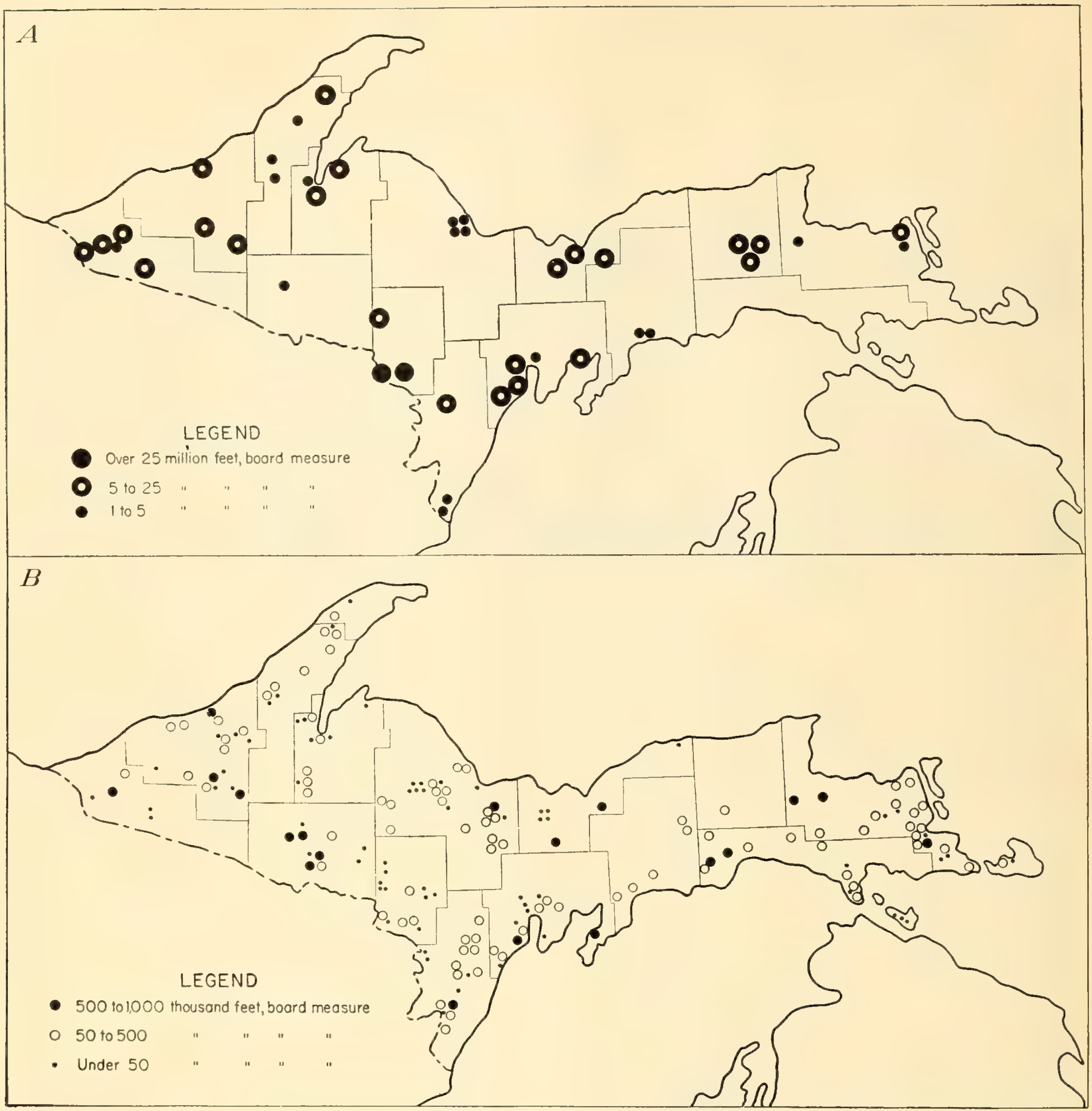

Figure 3.—*Location of sawmills in the Upper Peninsula:* A, *Mills cutting 1 million board feet or more annually;* B, *mills cutting less than 1 million board feet.*

cannot now be considered inaccessible. Most of the Peninsula lies within a 400-mile radius of Chicago or Detroit and, with the excellent system of railroads and highways which have been developed, all principal points are within a 12- to 15-hour run by car or train. The average freight rate on lumber from Iron Mountain to Chicago is only $3.40 per M board feet as compared with $7.60 from Louisiana and $14.40 from Washington and Oregon.

With this increase in accessibility of the virgin timber, the exhaustion of timber supplies in lower Michigan and Wisconsin has forced lumber dealers and wood-using industries to look more and more to the Upper Peninsula, not only for lumber but also for veneer stock, furniture bolts, pulpwood, and other rough forest products. This increased demand tends to raise stumpage values and stimulate the rate of cutting.

Furthermore, decreased use of wood in automobile manufacture and changes in mine requirements are removing the incentives that impelled many of the large holding companies in these fields to maintain extensive timber reserves in the Upper Peninsula.

Finally, property taxes and other carrying charges have constituted a burden upon landowners, which has urged liquidation of investments on idle stumpage.

Data collected by the Forest Survey indicate early exhaustion of the mature and merchantable stands of timber if the present rate and method of cutting are not changed. In fact, certain sectors, notably around Menominee, Escanaba, and Sault Ste. Marie, are largely cut out already and a number of mills have been shut down. Other areas are rapidly approaching the same condition.

An equally important disclosure of the Forest Survey is the number, diversity, and importance of forest industries in the Upper Peninsula. No less than 280 primary forest industries were operating in the Peninsula in 1934, including 221 sawmills, 3 veneer mills, 4 wooden-container mills, 5 pulp and paper mills, 5 hardwood-distillation plants, 17 shingle mills, 22 lath mills, and 3 miscellaneous wooden-product industries (figs. 1, 2, 3, and 4). Table 2 gives statistics on forest-industry production and employment. Normal annual industrial employment, including the associated woods work, is estimated at 2½ million man-days, or about 200 days' work each for 13,000 men.

Table 2 shows the production and employment for shorter periods in miscellaneous woods work not associated with local industries—such as the cutting of ties, white-cedar products, fuel wood, and mine timbers—to amount annually to nearly 2 million man-days, or 100 days' work for 19,000 men. Thus a total of about 32,000 men find employment for periods of 100 or 200 days per year in forest industries and woods work. In addition, an undetermined number of people obtain some income by cutting Christmas trees and greens, and by gathering blueberries, sphagnum moss, cones, and other forest by-products.

Accurate statistics are lacking, but it is estimated that some $20,000,000 of private capital is invested in sawmills and other primary wood-using industrial plants (not including paper mills and other secondary wood-using industries) in the Upper Peninsula, and $100,000,000 in timber and timberland, or $120,000,000 in all.

Farming and forestry work are closely associated

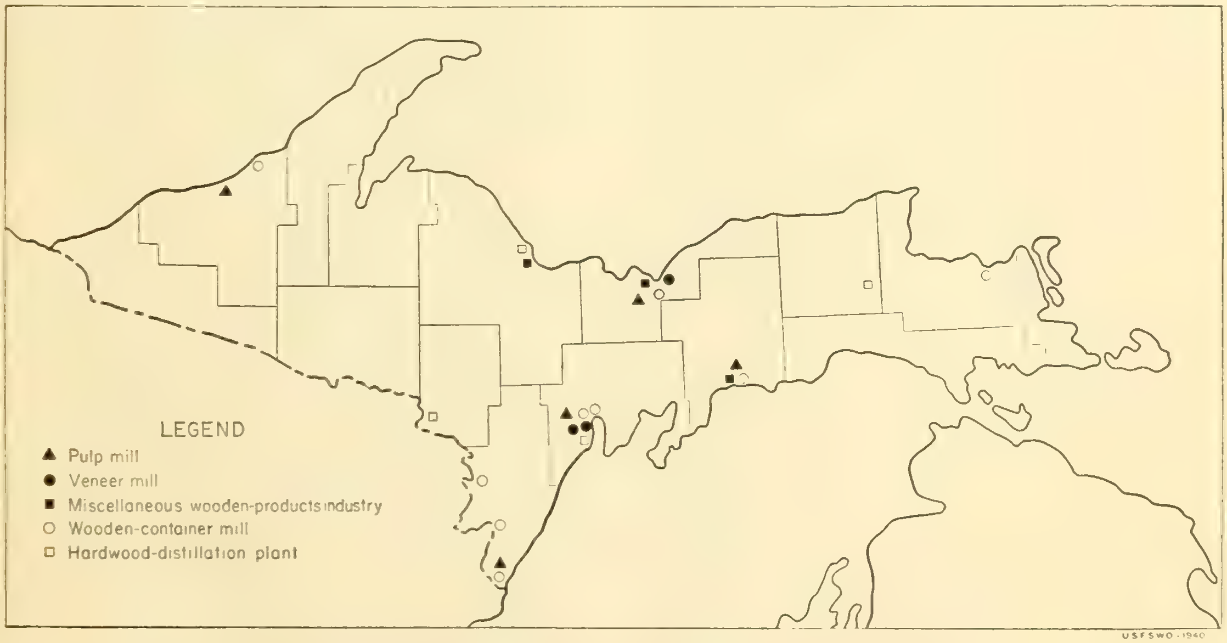

FIGURE 4.—*Pulp mills and other primary wood-using industries in the Upper Peninsula*

in many parts of this area. More than half the farm operators reported some work off the farm in the 1935 Census of Agriculture. Their average period of outside employment was 94 days. How much of this time was spent in forestry work was not indicated, but doubtless several thousand farmers did some work in the woods, and 2,507 farmers sold forest products from their farms during the year. The value of these products in 1934 averaged $89 per farm. The Forest Survey records show that the average Upper Peninsula farmer uses annually 12.7 cords of fuel wood, 47 fence posts, and lesser quantities of poles and barn timbers.

The quantity of woods activity and the year-to-year stability of woods work are closely related to the welfare of a great many communities. In localities where the merchantable timber has been completely removed and the soil is unsuitable for farming, tax rates are higher, tax delinquency is increasing, and unemployment, relief, and inefficient public services are serious problems.

Mining

At its height, before and during the World War, the copper industry employed about 16,000 workers in Houghton County alone, and supported virtually alone a population of about 75,000. As late as 1923–24, the copper mines employed 10,000 to 12,000 persons, but owing to higher production cost and lower copper prices during the past few years, less than 2,000 of these workers were regularly employed in 1933. Experts predict that the known reserves of commercial copper ore will be used up in the near future. Consequently great expansion in employment is not to be expected.

Iron-ore reserves are somewhat more plentiful, but high-grade ores are limited. There are about 160 million tons of merchantable ore in sight with normal depletion about 10 to 12 million tons annually. Allowing 25 percent for new discoveries, expected life would be 18 to 20 years. There are estimated to be over 5 billion tons of low-grade iron ore, containing excess silica or deleterious impurities such as sulfur and phosphorus. Mining engineers have hopes of developing methods of beneficiation which will make these low-grade ores usable, but in the meantime the low-grade ores have little or no commercial value. Thus, as a basis for permanent industrial activity in the Upper Peninsula, the mines have definite limitations.

Fishing

The Great Lakes yield almost two-thirds of the value of all fresh-water fish taken commercially in the United States. The total value of the Michigan catch (Upper and Lower Peninsulas) was about $2,500,000 in 1937. At the present time, however, overfishing constitutes a serious menace to the stock and immediate prospects for additional employment in this field are not promising.

Recreation

One other industry that promises to help tide the Upper Peninsula over a period of slackening industrial activity is the tourist trade. A pleasant summer climate, abundant water, attractive natural scenery, and an expanding system of good roads are drawing summer tourists in increasing numbers. The business of housing, feeding, and otherwise serving these travelers is a major source of cash income for a large section of the local population.

Tourist trade is not a year-round activity, and is not uniform from one year to the next. It will probably prove most helpful, in the long run, if it is integrated with farming, forestry, and other occupations. Integration with forestry is the most important, inasmuch as the timber-bordered lakes and highways are among the principal recreational attractions in the area.

Forest Tax Situation

Taxation as it relates to forest management has been made the subject of an exhaustive study by the Forest Service.[8] Here it is necessary only to emphasize a few points peculiarly applicable to the Upper Peninsula.

Some local governmental units, because their ore and standing timber are being steadily depleted, are faced with the necessity of making downward adjustments in services to fit the local tax-paying capacity. Owing to the inflexibility of many items of governmental costs, such adjustments are slow and difficult. Lags in adjustment have resulted in some high levies on real property.

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[8] FAIRCHILD, FRED ROGERS. FOREST TAXATION IN THE UNITED STATES. U. S. Dept. Agr. Misc. Pub. 218, 681 pp. illus. 1935.

Among other unfortunate effects, high taxes have tended to discourage private-forest management for continuous production. Annual taxes on cutover land, which will not yield merchantable forest products in less than 50 to 100 years, make private ownership of this kind of land unattractive. The increase in tax burden when young second growth becomes merchantable and is recognized in the assessment tends to encourage premature cutting. Taxation, among other factors, hastens the liquidation of the remaining mature forests.

It may be said that present levies, which a recent constitutional amendment limits to 15 mills for current expenses, are not generally very burdensome. However, this limit may be exceeded by levies for servicing debts contracted before Dec. 8, 1932, and for current expenses by vote of the township concerned. Accordingly, 7 out of the 150 townships in the Upper Peninsula in 1938 still had rates of over 30 mills for current expenses, and 9 had rates of over 30 mills for total expenses. These were mainly in the western part of the Peninsula, where the greater part of the taxes are paid by nonresident timber owners and mining companies.

Michigan has a forest-tax law which provides, in lieu of the usual ad valorem tax, a specific tax of 5 cents an acre on the land and a 10-percent yield tax on the value of the timber when cut. This is known as the Commercial Forest Reserve or Pearson Act. About 90,000 acres in the upper Peninsula had been classified up to April 1, 1938. The 1939 Legislature changed the law to admit selectively logged lands and reduced penalties for withdrawal from listing. Previously any tract of mature forest growth was ineligible.

Among the taxes other than on property and forest yield to which timber owners and operators are subject, inheritance and estate taxes may have some effect on the stability of forest ownership. Income, social security, and various business taxes involve few, if any, problems which are peculiar to forest operations.

Present Condition of Timbered Areas

THE 9,336,000 acres of uncleared forest land in the Upper Peninsula supports a forest growth that only patchily represents the original (see colored map at end of report). As nearly as can be estimated, the original forests consisted of four major types in about the following proportions:

	Acres
Hardwoods	4,750,000
Spruce-fir	2,500,000
Pine	1,600,000
Conifer swamp	1,400,000
Total	10,250,000

The hardwood forests were mixtures of sugar maple, hemlock, yellow birch, elm, basswood, and beech. Islands of white pine occurred in many localities. Volumes ranged from 5 to 30 M board feet per acre, the heavier stands including a large proportion of the softwood species.

The spruce-fir forests, which occupied rock outcrops adjacent to the Great Lakes and swamp margins and other poorly drained lands in the interior, were a conglomeration of hardwoods and softwoods in which balsam fir, white spruce, white-cedar, soft maple, paper birch, and various poplars were most prominent. Judging by the samples of old growth that remain, white-cedar, white spruce, and balsam fir made up a little more than half of the total volume; about one-sixth consisted of hemlock, tamarack, and pine; and the remaining one-third of hardwoods, such as yellow birch, soft maple, American elm, and various species of poplar.

Pine forests held most of the sandy areas. White pine, red pine, and jack pine were present in the

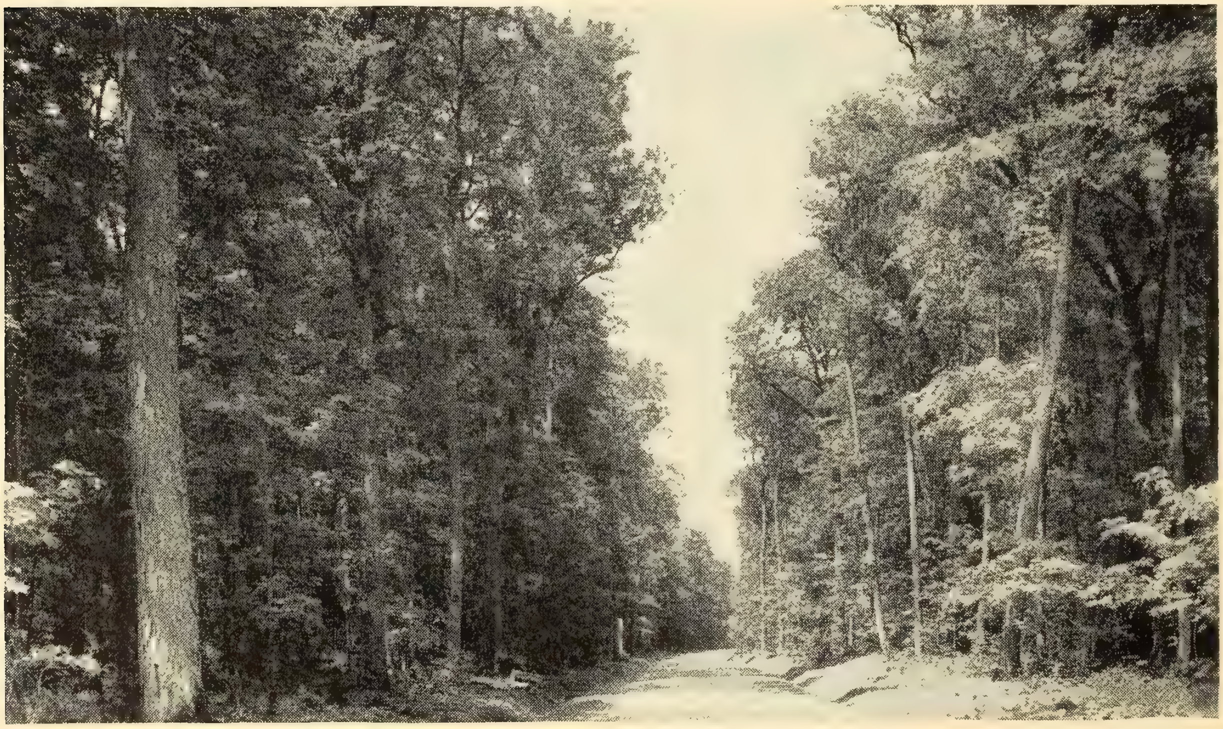

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FIGURE 5.—*Virgin stand of northern hardwoods—sugar maple, yellow birch, hemlock, and elm.*

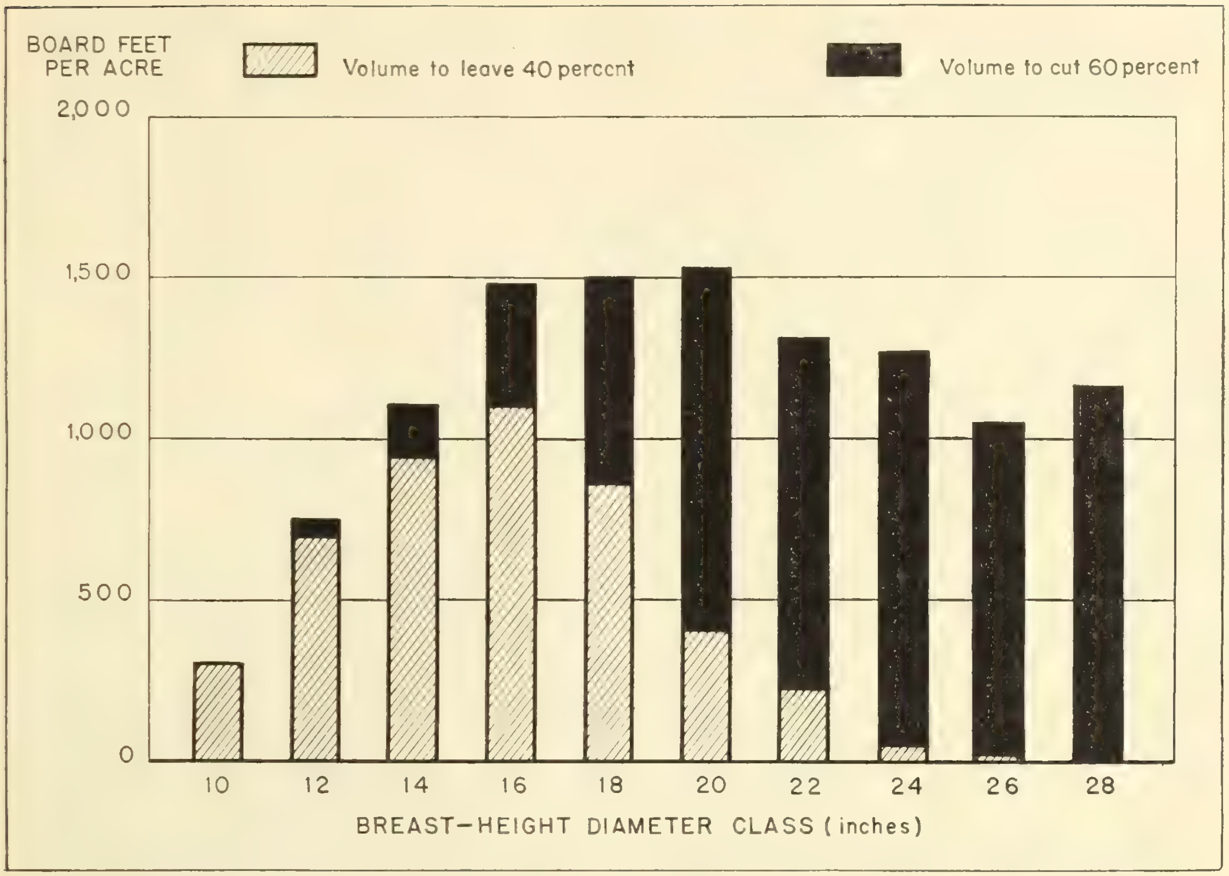

FIGURE 6.—*How a selective-logging operation in a typical old-growth northern hardwood forest provides for continued crops of timber.*

original forest, white pine prevailing on the better soils, jack pine on the poorest.

The conifer swamp forests consisted of stands of black spruce, tamarack, and white-cedar in peat swamps. The largest swamps were in the eastern part of the Peninsula.

Present acreage of pine is about 25 percent of the original; that of the spruce-fir type about 45 percent; of conifer swamps, 75 percent; and of hardwoods, 72 percent. More than three-fourths of the virgin forest has been cut over (see colored map), and of this about 917,000 acres has been cleared for villages, farms, and industry. Of the 9.3 million acres of forest land uncleared, 1.2 million has been at least temporarily deforested (table 3) and is now occupied by sweet fern, grass, and brush. Some 2.1 million acres has restocked with aspen and scrub trees. The remaining 6 million acres is still of the original type but only 2,412,000 acres, or 25.9 percent of the whole forest area, is classified as bearing trees of saw-timber size. In contrast, 55.6 percent of the forest area is deforested or is restocking with small trees. Compared with a managed forest much too large a share of the acreage, even in this comparatively well-timbered part of the Lake States, is occupied by very young timber.

For saw-timber production, the best remaining forests are the northern hardwoods, which total nearly 3¼ million acres, including 1½ million acres of old growth. The old-growth forests of sugar maple, yellow birch, hemlock, basswood, elm, etc., average more than 160 years and run 11.4 M board feet, lumber tally, per acre. The typical stand is uneven in both age and size, ranging from seedlings up to mature trees 30 inches or more in diameter (fig. 5). Such stands lend themselves to a selective type of logging, in which the larger and overmature trees are cut and the smaller

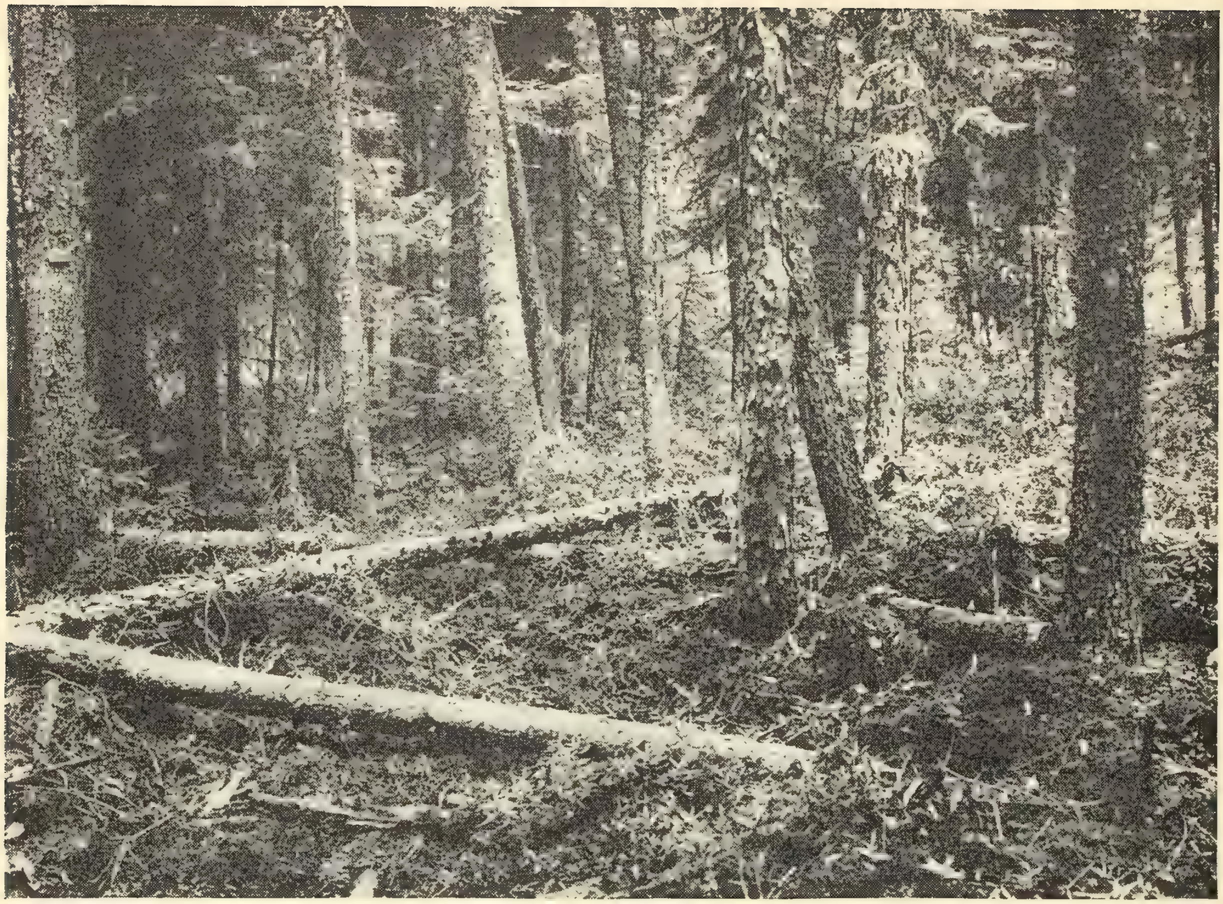

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FIGURE 7.—*A forest survey plot in black spruce cordwood, running about 10 cords per acre.*

and thriftier trees are left for a future crop. How a selective cutting operates in a typical stand is illustrated in figure 6. The detail of such an operation is given in table 4.

Thus far most stands have been clear cut; and the greater share of the reproduction stands is not yet beyond the cordwood class. Second-growth hardwood saw-timber areas total only 368,000 acres, and the saw-timber volume on them at present averages only 4,300 board feet per acre. It is estimated that the second growth averages about 111 years, the cordwood 47 years, and the restocking stands 24 years.

In the young second-growth and cordwood stands that make up the bulk of the present spruce-fir forests, balsam fir, quaking aspen, and paper birch are most prominent. Old-growth spruce-fir saw-timber stands have an average volume of 5,810 board feet per acre. Cordwood stands average 11.5 cords per acre, including about 4.1 cords suitable for pulpwood.

Conifer swamp forests probably rank second to the northern hardwoods in commercial value, on account of the demand for poles and pulpwood. Present cordwood stands of black spruce average 9.9 cords per acre of all kinds of material, including about 5.9 cords suitable for pulpwood (fig. 7).

Most of the pine forests are immature and understocked. Old growth remains on only 46,000 acres and second-growth saw timber on 41,000 acres, and these are in scattered patches of which many are inaccessible (fig. 8). The old growth averages only 8,000 board feet per acre, whereas stands of 25,000 board feet were common in the original forest. Present second-growth averages only 3,500 board feet per acre. The pine cordwood areas, amounting to 117,000 acres, half of which are dominated by jack pine, are likewise poorly stocked.

TABLE 3.—*Present area of forest land in the Upper Peninsula by forest-cover type and size class* [1]

Forest-cover type and size class	Area	
	1,000 acres	*Percent*
White pine	120	
Red pine	50	
Jack pine	233	
Pine		4.3
Spruce-fir	1,135	12.2
Spruce swamp	429	
Tamarack swamp	173	
"Cedar" swamp	446	
Conifer swamp		11.2
Northern hardwoods	3,222	
Ash-elm (lowland hardwoods)	200	
Hardwoods		36.7
Aspen-birch	2,082	
Scrub	22	
Nonproductive swamp	20	
Nonproductive		22.7
Deforested	1,204	12.9
Total	9,336	100.0
Old-growth saw timber	1,658	17.8
Second-growth saw timber	754	8.1
Cordwood	1,727	18.5
Fair to good restocking	2,134	22.8
Poor restocking	1,859	19.9
Deforested	1,204	12.9
Total	9,336	100.0

[1] See table 17, Appendix, for more details of size-class distribution.

TABLE 4.—*Volume per average acre cut and left in a selective-logging operation in a typical old-growth northern hardwood forest, by diameter classes*

Diameter class (inches)	Original stand			Volume cut		Volume left	
	Trees	Basal area	Saw-timber volume				
	Number	*Square feet*	*Board feet*	*Percent*	*Board feet*	*Percent*	*Board feet*
2-8	259.3	22.2					
10	17.0	9.3	300	0	0	100	300
12	14.5	11.4	750	7	50	93	700
14	11.9	12.7	1,100	15	165	85	935
16	10.3	14.4	1,470	26	380	74	1,090
18	7.9	13.9	1,500	43	645	57	855
20	5.8	12.6	1,530	74	1,130	26	400
22	3.9	10.3	1,300	83	1,080	17	220
24	2.7	8.5	1,250	96	1,200	4	50
26	1.7	6.3	1,040	99	1,030	1	10
28+	2.0	9.9	1,160	100	1,160	0	0
Total	337.0	131.5	11,400	60	6,840	40	4,560

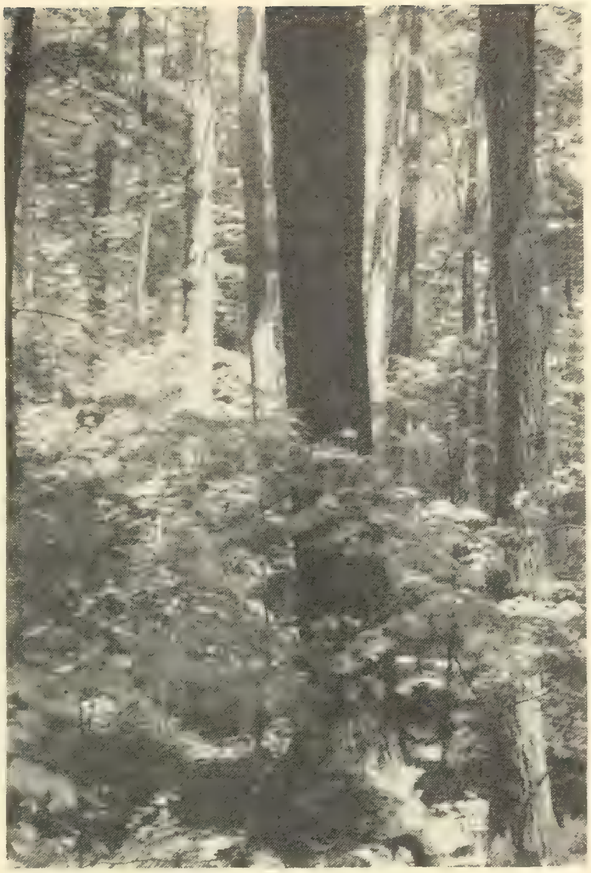

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FIGURE 8.—*Old-growth pine mixed with hardwood. Few areas of pure old-growth pine remain in the Upper Peninsula.*

The average volume per acre is only 8.3 cords. The restocking areas are almost exclusively jack pine type, and two-thirds have been classified as of poor density (less than 40 percent stocked). Of all types, pine is probably the most depleted (fig. 9).

The aspen and scrub forests, which have developed largely at the expense of other types after logging, are in general immature (fig. 10). Only 3 percent of the area supports timber of sawlog size, and the few saw-timber stands average but 4,440 board feet per acre. Cordwood stands average 8.3 cords per acre and cover 25 percent of the aspen area. The rest is restocking, but more than half the restocking area is of poor density.

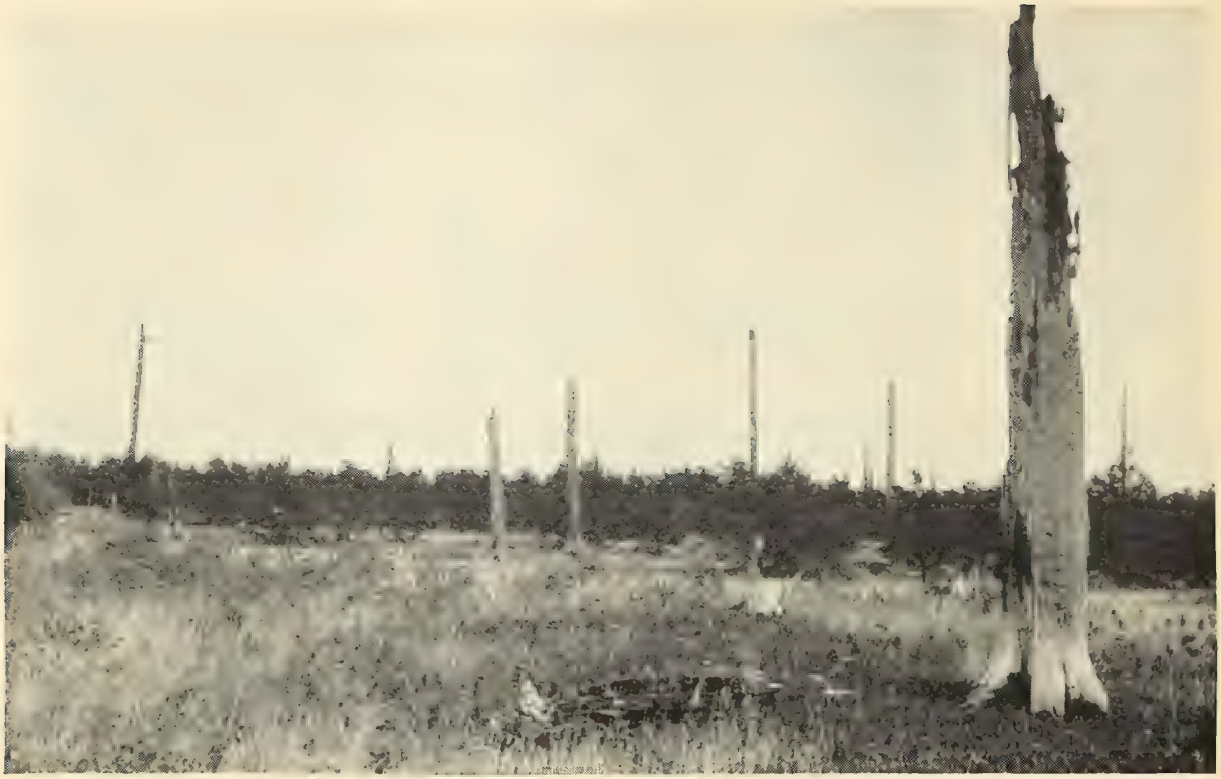

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FIGURE 9.—*Burned-over pine land restocking to jack pine.*

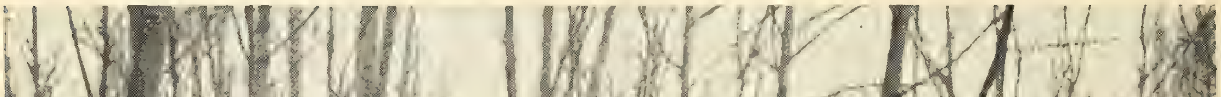

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FIGURE 10.—*Aspen and soft maple coming in on cut-over hardwood land.*

Timber Volumes

THE total volume of 8.4 billion cubic feet of solid wood (table 5) represents an average per acre of approximately 900 cubic feet, or 12 standard cords. This is nearly 3 times the average for the rest of the Lake States region. About 44 percent of the total volume is saw timber; 56 percent consists of cordwood and white-cedar piece products.

Saw Timber

The estimated 23¼ billion board feet of saw timber shown in table 5 is a greater volume than has usually been credited to the Peninsula. It must be borne in mind, however, that this includes not only the merchantable-timber stands but also the volume of scattered trees on cut-over lands. All trees 9.0 inches d. b. h. or more are included. The volume is given in terms of International ¼-inch rule, which overruns Scribner log scale in stands of this kind by about 14 percent, and corresponds closely to green lumber tally. Approximately 21 percent of the total saw-timber volume is in trees less than 14 inches in diameter and in larger trees scattered over cordwood and restocking areas.

TABLE 5.—*Summary of timber volumes in the Upper Peninsula, by products, 1935*

Product	Volume of standing timber	Equivalent in terms of—	
		Solid wood	All merchantable timber
	Million board feet	*Million cubic feet*	*Percent*
Saw timber (International rule ¼" kerf)	[1] 23,284	3,675	43.6
Additional cords: [2]	*1,000 cords*		
Small trees	23,987	1,799	......
Tops and limbs	18,813	1,411	......
Cull in sawlog trees	12,400	930	......
Total	55,200	4,140	49.1
White-cedar products:	*1,000 pieces*		
Poles	20,869	224	......
Round posts	91,325	145	......
Other piece products	......	94	......
Other "cedar" volume [3]	......	147	......
Total	......	610	7.3
All merchantable trees	......	[1] 8,425	100.0
	1,000 cords		
Cull trees	12,320	924	

[1] Between 1935, when the field work for the survey was done, and 1940, it is estimated, the saw-timber volume decreased about 2 billion board feet to 21,200 million board feet (see table 29, Appendix), and the total merchantable-tree volume decreased to about 8,000 million cubic feet.

[2] Exclusive of white-cedar. Small trees include scrub trees of large diameter but too short and rough for sawlogs.

[3] Other "cedar" volume includes small white-cedar trees containing no piece products, as well as tops above piece products.

TABLE 6.—*Volume of saw timber in the west and east halves of the Upper Peninsula, by species, 1935* [1]

Species	West half	East half	Total
	Million board feet	*Million board feet*	*Million board feet*
Softwoods:			
White pine	545	268	813
Red pine	37	47	84
Jack pine	28	27	55
Spruce	693	266	959
Balsam fir	297	272	569
Tamarack	18	38	56
Hemlock	4,832	1,530	6,362
Total	6,450	2,448	8,898
Hardwoods:			
Sugar maple	4,671	2,062	6,733
Yellow birch	2,679	1,046	3,725
Basswood	385	66	451
Elm	287	150	437
Beech	17	947	964
Oaks	58	6	64
Aspen	167	384	551
Paper birch	91	201	292
Soft maples	506	337	843
Miscellaneous	250	76	326
Total	9,111	5,275	14,386
All species	15,561	7,723	23,284

[1] Between 1935 and 1940 drain exceeded growth in most species and total sawlog volume decreased 2 billion board feet to 21,200 million. As of 1940, the softwood volume is about 8,000 million board feet and hardwood 13,200 million board feet. (See table 29 in Appendix for estimate by species.)

The species most important from a saw-timber standpoint are eastern hemlock, sugar maple, yellow birch, and American basswood. The recorded volumes of these species (table 6) total 17.3 billion board feet, of which about 15.1 billion feet are in 14-inch or larger trees in stands of 2,000 board feet or more per acre.

Pulpwood

The total volume of 6 principal pulping species in the Upper Peninsula is approximately 40 million cords (table 7), including 31 percent of all the spruce, 43 percent of all the balsam fir, and 67 percent of all the hemlock found in the Lake States. This volume, however, is not all available for use as pulpwood. The 10¾ million cords listed as "other material" consists of wood too small or rough to pass as standard pulpwood under present specifications, and also includes cull in saw-timber trees. The sawlog material may be used as pulpwood but much will probably be used for other products. Only about 11 million cords has been classified as standard pulpwood below sawlog size.

TABLE 7.—*Volume of pulpwood timber in the Upper Peninsula, by species, 1935*

Species	Sawlog material	Small trees	In tops and limbs	Other material	Total volume
	M cords	*M cords*	*M cords*	*M cords*	*M cords*
Spruces	2, 213	2, 135	500	431	5, 279
Balsam fir	1, 333	3, 134	500	739	5, 706
Jack pine	134	336	40	104	614
Hemlock	13, 120	1, 081	1, 200	6, 786	22, 187
Tamarack	147	305	60	48	560
Aspen	1, 294	1, 497	210	2, 639	5, 640
Total	18, 241	8, 488	2, 510	10, 747	39, 986

Chemical Wood

Michigan has been one of the leading producers of charcoal and wood chemicals, and there is a considerable local demand for wood suitable for this use. The inventory shows nearly 27 million cords of maple, yellow birch, and beech (table 8) exclusive of sawlogs. Of this volume, about 10 million cords is in small sound trees which should not be cut, but 17 million cords is sawlog cull or tops and limbs of saw-timber trees which can be used whenever the saw timber is cut. Approximately two-thirds of this volume is in the western half of the Peninsula, while most of the chemical plants are in the central or eastern portion.

TABLE 8.—*Cordwood volume of timber in the Upper Peninsula commonly used for chemical distillation, by species, 1935*

Species	Saw-timber trees [1]	Trees below saw-timber size	Total volume
	M cords	*M cords*	*M cords*
Sugar maple	9, 300	4, 434	13, 734
Soft maples	1, 170	2, 390	3, 560
Yellow birch	5, 200	2, 480	7, 680
Beech	1, 340	500	1, 840
Total	17, 010	9, 804	26, 814

[1] Tops, limbs, and cull logs.

White-cedar Poles and Posts

The Forest Survey estimate for white-cedar poles in the Upper Peninsula is nearly 21 million, of which 71.3 percent are 25 feet or less in length and only 12.1 percent are 35 feet or longer (table 9). The white-cedar inventory also includes more than 91¼ million round posts and 94 million cubic feet of other piece products. The Upper Peninsula has 41 percent of all round "cedar" fence posts and 50 percent of all the "cedar" poles standing in the Lake States.

Cull-tree Volume

In addition to the volume in merchantable trees estimated, there is a cull-tree volume of 12,320,000 cords. Of little immediate value commercially, this material nevertheless is available for firewood, low-grade pulpwood, or distillation wood. Approximately 69 percent of the cull-tree volume is found in the northern hardwood type, 14 percent in the spruce-fir, 5 percent in aspen, 5 percent in "cedar" swamps, and the rest scattered throughout the other types. Not quite half (48 percent) of this volume is in old-growth stands, 16 percent is in second-growth stands, 15 percent is in cordwood, and 21 percent on restocking and deforested areas.

TABLE 9.—*White-cedar products in the Upper Peninsula, 1935*

Product	Number	Volume
	1,000 pieces	*1,000 cubic feet*
Round posts	91, 325	145, 000
Poles (by length):		
20 feet or less	8, 272	----------
25 feet	6, 599	----------
30 feet	3, 465	----------
35 feet	1, 862	----------
40 feet	443	----------
45 feet	228	----------
Total poles	20, 869	224, 000
Other piece products [1]	----------	94, 000
All products	----------	463, 000

[1] Material suitable for ties, shingles, lagging.

Timber Growth and Drain

Current Growth

IN SPITE of the clear-cutting practices and fires in the Upper Peninsula, the cut-over and burned-over lands are slowly restoring themselves to a productive condition. On the 4 million acres of restocking land, the annual rate of growth, computed for the next 10 years, averages 19 cubic feet, or about one-fourth cord per acre. A little more than half of this growth consists of pines, spruces, sugar maple, and other valuable species. The other half is aspen, paper birch, scrub oak, red and silver maples, and miscellaneous inferior hardwoods. If this rate of growth is maintained most of these restocking areas will become cordwood forests within 20 years, but spruce and tamarack swamps will require at least another 40 years to reach cordwood size. (See table 23, Appendix.)

Cordwood stands, which cover nearly 1¾ million acres, are growing at the rate of 29 cubic feet per acre per year, about two-fifths of a cord. Two-thirds of this new volume is aspen, paper birch, and other inferior hardwoods. Second-growth saw-timber stands, covering three-quarters of a million acres and containing nearly 3 billion board feet, are growing at the rate of 91 board feet per acre. Only one-third of this is of inferior species.

The 1.7 million acres of old-growth saw timber, which contains most of the merchantable timber in the Upper Peninsula, has an average net annual increment of 72 board feet per acre. This relatively low rate, less than 1 percent of the base volume, is to be expected in mature and overmature stands where most of the growth is offset by death and decay. Undisturbed overmature timber does, of course, eventually reach a static condition with growth being entirely offset by death and decay. In the Upper Peninsula, however, many of the mature hardwood stands have been disturbed by the cutting of white pine and a few hardwoods in earlier years and the gaps caused by this cutting are still being filled.

The total current annual increment in the Upper Peninsula is 343.5 million board feet. Of this total, 189 million board feet is in saw-timber stands, while the remainder is largely in scattered saw-timber trees in stands which are still unmerchantable except for cordwood products (table 10).

TABLE 10.—*Current annual increment in each size class of stand*[1]

Size class	Sawlog volume		Total volume	
	Per acre	Total	Per acre	Total
	Board feet	*M board feet*	*Cubic feet*	*M cubic feet*
Old-growth stands	72	120, 300	13	21, 900
Second-growth stands	91	68, 800	15	11, 000
Cordwood stands	58	100, 300	29	51, 600
Restocking areas	12	49, 600	19	74, 200
Deforested areas	4	4, 500	2	2, 200
Average and total	37	343, 500	18	160, 900

[1] Estimated for decade 1940–49.

Allowable Annual Drain

Current increment is only one of the factors determining how much timber should be removed from the forest each year. Another consideration is the condition of the growing stock. If the forest is overmature and overstocked, more volume can be removed than is replaced by growth until the forest is brought to a thrifty growing condition. If the stands are young and understocked, the annual removal should be less than current growth until an adequate growing stock has accumulated. Removing the entire current increment would serve to keep the forest permanently in an understocked condition.

Another factor is the method of cutting. Other things being equal, more timber can be cut annually if the method of cutting is such as to stimulate growth on the remaining stand and if all trees are cut at the right stage of development. Destructive logging and removal of immature

Table 11.—*Estimated allowable annual drain under a system of good forest management*

Period	Merchantable trees			Cull tree volume
	Sawlog volume	Cordwood volume	Total volume	
	Million board feet	*M cords*	*Million cubic feet*	*M cords*
First 20 years	589	1, 183	180. 8	2, 862
Second 20 years	550	1, 100	170. 0	(1)
Third 20 years	650	1, 300	200. 0	(1)
Eventual	1, 000	2, 000	300. 0	(1)

[1] Not estimated.

timber naturally reduce the yield capacity of the forest.

The old-growth northern hardwoods, which comprise about 18 percent of the Upper Peninsula forest area, are in what might be called an overstocked condition. Growth on this land would be greatly stimulated (probably doubled) if half the volume were removed by careful selective logging. Such an operation spread over a 20-year period would yield about 450 million board feet per year as an average. During the second and subsequent 20-year periods the same area should yield from 250 to 300 million board feet each year.

The second-growth saw timber, cordwood, and restocking areas are growing at the rate of 223 million board feet per year. To build up a balanced growing stock within a period of 40 years will require retention of about half of this growth in the forest. For the first 20-year period this would mean that about 139 million board feet in large scattered trees could be logged each year, while an equivalent volume should be allowed to accumulate on small thrifty trees to improve the forest. During the second 20-year period about 275 million board feet could be logged each year and after 40 years approximately 350 to 400 million board feet per year.

With good management, therefore, it would be possible to cut from all classes of forest land about 590 million board feet of saw timber (table 11) each year while putting the forest in a better growing condition. After 40 years, this yield would be advanced to 600 to 700 million board feet, and eventually 1,000 million board feet or more should be available.

From tops, limbs, and cull sections of the trees cut for sawlogs and from thinnings or other cuttings on cordwood stands, about 1⅛ million cords of sound cordwood can now be obtained each year. This yield need be only slightly reduced after the first 20 years and would eventually reach about 2 million cords.

The solid cubic volume of allowable drain of saw timber and cordwood together during the first 20 years amounting to 181 million cubic feet would be reduced during the second period by 10 or 11 million feet, but would eventually reach half again the present yield.

Normal Actual Drain

Saw Timber

In a normal year, about 688 million board feet of saw timber is cut for industrial or domestic use or wasted in logging and 70 million more is lost through fire or other damaging agencies[9] (table 12). Thus the total annual drain is 758 million board feet.

Table 12.—*Normal annual drain on merchantable timber*

Agency	Saw timber	Cordwood [1]	Total volume
	M board feet	*Cords*	*M cubic feet*
Cutting [2]	688, 500	1, 484, 000	219, 900
Fire	11, 700	58, 000	6, 200
Other depleting agencies	58, 200	158, 000	21, 100
Total	758, 400	1, 700, 000	247, 200

[1] All cedar products included.
[2] Includes unutilized merchantable material.

Cutting for lumber normally accounts for only 53 percent of the logging depletion (see table 26, Appendix). Other major items are cuttings for pulpwood, mine timbers, distillation wood, ties, fuel wood, veneer logs, container logs, and woodenware logs. Drain has fluctuated considerably in recent years, as indicated by statistics on sawmill output (see table 16, Appendix). The best 3-year average for the period 1924–33 for Upper Peninsula mills was 630 million board feet. Actual production in 1934, however, was only 217 million board feet. In 1936, it rose to 381 million board feet and in 1937 was close to 400 million. Production during 1938 and 1939 again declined, but the normal production figure fixed at 380 million board feet of lumber and sawed ties seems reasonable for normal business conditions.

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[9] Estimated normal drain from logging is based upon past averages for individual mills, modified in some respects by the judgment of the operators as to future production. Fire losses are estimated from actual losses during the period 1928–35. Other losses amount to about one-fourth of 1 percent of the present stand.

Cordwood

Of the 1½ million cords of merchantable non-sawlog material cut or destroyed annually in the Upper Peninsula forests, about 340,000 cords is used for pulpwood, 181,000 cords for fuel wood, and 62,000 cords for distillation wood. Some is used for mine poles and lagging and some for various minor products, but more than half of the total volume is wasted. It is left in the woods in the form of tops, long butts, cull logs, or is destroyed by fires, insects, and other destructive agencies.

In addition to the cordwood in merchantable trees, about 541,000 cords is cut from cull trees or other unmerchantable material. Three-fourths of this is used for fuel, but appreciable quantities are utilized as distillation wood, pulpwood, and mine timbers.

Total Volume of Merchantable Wood

Total present annual drain of all kinds of merchantable timber is 247.2 million cubic feet. The proportion going into various products is as follows:

	Percent
Lumber	23
Pulpwood	15
Fuel wood	9
Distillation	5
Mine timbers	3
Ties	2
Posts	2
Miscellaneous products	5
Logging waste	25
Fire, insects, etc	11
Total	100

Annual Increment and Drain Compared

Little can be learned by lump-sum comparisons of current drain with either current growth or the estimated allowable cut under good management. Without consideration of the species and kinds of timber being cut and the methods of cutting, such comparisons would be meaningless. A summary of 1935 volume and estimates for the decade 1940–49 of the annual increment and allowable and actual drain, by species and kind of timber, are given in table 13.

Pine

Three-fourths of the white and red pine saw-timber volume is in large trees in sawlog stands (table 21, Appendix). Most is in small patches intermingled with northern hardwood or swamp forest. About 60 percent of the current increment, however—17.9 million board feet out of a total of 29.6 million—is on cordwood and restocking lands (table 24, Appendix). To protect and stimulate

Table 13.—*Volume (1935) and increment and allowable and normal actual drain for certain products and species groups, as estimated for 1940–49*

SAW TIMBER (IN MILLION BOARD FEET)

Species	Volume (1935)	Annual increment	Allowable annual drain	Normal actual drain
Softwoods:				
White and red pine	897	29. 6	22. 7	31. 2
Hemlock	6, 362	49. 8	168. 3	149. 4
Other softwoods	1, 639	40. 4	37. 1	111. 1
Total	8, 898	119. 8	228. 1	291. 7
Hardwoods:				
Maple, birch, basswood, beech	11, 873	132. 4	277. 8	400. 7
Other hardwoods	2, 513	91. 3	83. 0	66. 0
Total	14, 386	223. 7	360. 8	466. 7
All species	23, 284	343. 5	588. 9	758. 4
TOTAL VOLUME (IN MILLION CUBIC FEET)				
Pulping species:				
Spruce	396	7. 9	6. 7	24. 2
Balsam fir	428	6. 5	4. 8	13. 7
Hemlock	1, 664	13. 1	37. 7	39. 0
Jack pine	46	1. 8	0. 3	4. 6
Tamarack	42	2. 1	1. 1	2. 6
Aspen	423	42. 9	25. 0	8. 5
Total	2, 999	74. 3	75. 6	92. 6
All other species	5, 426	86. 6	105. 2	154. 6
All species	8, 425	160. 9	180. 8	247. 2
CULL-TREE VOLUME (IN THOUSAND CORDS)				
All species	12, 320	2. 246	[1] 2, 862	541

[1] Consists of 5 percent of the accumulated cull-tree volume plus the volume currently becoming cull. It has been estimated that roughly 2 percent of the present merchantable volume will become cull each year as a result of accident, decadence, and suppression.

this growth, cutting should be confined to the mature and overmature stands, and should not exceed 22.7 million board feet on the average (table 25, Appendix). Current drain is apparently about 31.2 million board feet per year (table 27, Appendix).

If partial cutting in old-growth stands—i. e., removal of old trees while leaving young thrifty trees to grow—will prove practicable, annual growth on saw-timber areas can doubtless be stimulated during the next two decades and the allowable cut increased accordingly. In other words, it is not out of the question that current levels of industrial utilization be maintained, if fire and other losses are minimized and cutting practices that will stimulate growth on saw-timber areas are generally applied.

Hemlock

More than one-fourth of the total sawlog volume in the Upper Peninsula is eastern hemlock. The bulk of this volume (98 percent) is in saw-timber stands and mostly in trees 14 inches or larger in diameter. It is associated commonly with maple, birch, elm, and other hardwoods.

Hemlock is a tree of the climax forest and does not appear commonly in the second growth. It does not reproduce well on cut-over lands and when left in selectively logged stands it usually succumbs to windthrow, sunscald, or insect damage. Depending upon market conditions, it seems logical in stands made up mainly of hemlock either to cut the species clean or leave the stand intact until the market improves. In the meantime, experiments with various types of partial cutting adapted to hemlock should be tried.

On account of difficulties in management and the relatively low value of this species, the allowable cut has been set fairly high—168 million board feet. This is more than three times the current increment and is somewhat greater than current drain.

Northern Hardwoods

About 3½ percent of maple, birch, basswood, and beech in saw-timber stands is being liquidated each year in clear-cutting operations. This means that, if continued at present rates, the commercial hardwood forests will be gone in 25 to 30 years. More probably, production will decline at an earlier date as certain individual operators cut out their holdings. There is always the possibility, however, that some change in markets or other economic factors may cause owners of large reserved tracts to throw them on the market, and a number of new mills may be constructed, thus shortening the period of liquidation.

If the old-growth hardwoods and the small tracts of merchantable second growth are clear-cut, forest industries will have to rely upon yields from the present cordwood and restocking areas. Unless definite efforts are made to conserve the growing stock on these areas now, it is not likely that the annual yields will greatly exceed the current increment, which is 46 million board feet per year (table 24, Appendix).

Under a plan of selective logging with thorough protection of immature stands, an annual yield of 278 million board feet of the four commercial hardwood species could be obtained on virtually a permanent basis. The yield during the second 20-year period might be slightly lower but could be increased to an even higher level in later periods.

If the forests are put under sustained-yield management, it would be necessary, in addition to adjusting the method of cutting, to reduce the actual volume of drain on maple, birch, beech, and basswood by about 123 million board feet. Reductions can be made in a number of places; in the 30 million feet going into distillation wood, in the 33 million feet of fire and other losses, in the 10 million feet of logging and milling waste, and in the saw timber used for fuel wood, posts, etc. But no doubt some downward adjustments in mill production will be necessary. This can probably better be accomplished by early closing of some of the old and obsolescent mills already nearing the end of their operating life than by attempting a proportionate reduction for all mills.

Pulping Species

The normal drain on spruce and balsam fir is 3.3 times the recommended drain. The disparity is still greater in the case of jack pine. Even tamarack is overcut more than 100 percent. This unfavorable condition is aggravated by the fact that practically all of the mature cordwood and saw timber of these species has already been cut. Present operations are chiefly taking out immature trees 5 to 8 inches d. b. h. and are thus progressively depleting the growing stock.

Possibilities for immediate increase in the yields of spruce, balsam fir, and jack pine are very limited, but the large numbers of small trees 3, 4, and 5 inches in diameter on restocking areas and scattered throughout the aspen stands give basis for the belief that volumes at least as large as the present cut could be obtained on a sustained-yield basis, if the growing stock were protected for about 20 years. In the meantime, only the larger trees scattered through the hardwood forests and the products of thinnings and improvement cuttings on swamps should be cut. This would yield only 11.8 million cubic feet of the three species in place of the 42.5 million cubic feet now cut or destroyed. To make up the difference, it might be possible to use more hemlock tops and slabs and more aspen, or it might be necessary to increase the already large imports of wood and pulp from Canada to Michigan and Wisconsin mills.

Inferior Species and Cull Material

The 12.3 million cords of cull timber already available and the large additional volumes which can be salvaged from suppressed, wind thrown, and damaged timber, once the forests are put under management, represent not only a great surplus of usable material but actually an obstacle to the full development of the forest. As such, its utilization offers a challenge to the manufacturing industries in the Upper Peninsula.

Consideration should be given first to the possibility of utilizing this material for certain products now made in whole or in part from merchantable trees. Important among these are distillation wood, firewood, fence posts, mine lagging, and car stakes.

Markets for inferior wood should be expanded by developing more efficient and cheaper methods of cutting, splitting, seasoning, loading, and hauling; by better planning of forest roads; and possibly by relocating manufacturing plants to reduce transportation of rough material.

New products that can be made from inferior woods must be sought in the laboratories, in the mills, and in the workshops of the local people. A large number of small uses will be just as effective as a few products in great demand for absorbing a large quantity of this material.

The Problems of Land Ownership and Balanced Utilization

THE complicated land-ownership pattern and the diversity of interests of individual owners are two of the serious obstacles to sustained-yield management in the Upper Peninsula. Few owners, including even the public agencies, have sufficient timberland of their own in consolidated blocks to support a moderate-sized logging operation permanently. Some owners are holding timberlands as a long-time investment; others are interested in immediate liquidation. Hence, cooperation is difficult.

The Federal Government owns nearly 1.4 million acres or 15 percent of the forest land, chiefly within two national forests (table 14). This land consists of remnants of public domain, and cut-over land that has been purchased for reforestation and supports only 1.2 percent of the saw-timber volume in the Peninsula. Furthermore, the Federal lands are poorly consolidated, since only 44 percent of the area within national-forest boundaries was Government owned in 1935. Thus the two national forests are in no condition at present to support large-scale operations on a sustained-yield basis.

Table 14.—*Ownership of forest land and timber, 1935*

FOREST LAND

Type or species	Federal and Indian	State and county	Large private holdings	Small private holdings	All owners
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
Pine	134	84	125	60	403
Hardwood	785	466	2,971	1,304	5,526
Spruce-fir	124	136	575	300	1,135
Conifer swamp	121	170	568	209	1,068
Deforested	236	144	517	307	1,204
Total	1,400	1,000	[1] 4,756	[1] 2,180	9,336
Percentage	15	11	51	23	100

SAW TIMBER

Type or species	Federal and Indian	State and county	Large private holdings	Small private holdings	All owners
	Million board feet	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*
Pine	9	91	586	266	952
Hemlock	104	195	4,788	1,275	6,362
Other softwoods	11	136	1,050	387	1,584
Maple-birch	192	347	7,764	2,155	10,458
Other hardwoods	64	270	2,593	1,001	3,928
Total	380	1,039	16,781	5,084	23,284
Percentage	2	4	72	22	100

[1] Of the land in this category, between 1 and 2 million acres is delinquent for taxes for 1936 and earlier years and is now becoming the property of the State.

Table 15.—*Classification of 124 owners holding 55 percent of the privately owned forest land in the Upper Peninsula*

Class	Owners	Aggregate holdings
	Number	*Acres*
Lumber and logging companies	44	1,056,900
Pulp and paper companies	8	366,100
Mining companies	8	1,198,100
Banks	3	14,200
Automobile and other manufacturing industries	8	419,600
Railroads	3	148,200
Land companies	10	178,900
Hunting clubs and resorts	7	127,700
Individuals and estates	31	262,700
Miscellaneous	2	5,200
Total	124	3,777,600

The State of Michigan and the several counties own 11 percent of the forest land, the greater part of which has come into public ownership through tax delinquency. It is relatively poor forest land and rather scattered. Of the 4 percent of saw-timber volume represented, the best is on land reserved for recreation. Obviously, the State by itself cannot support many large-scale operations.

Private owners, controlling 74 percent of the forest land and 94 percent of the saw-timber volume, represent a wide variety of interests. This is indicated in table 15, which presents data for 124 individuals or companies controlling about 55 percent of the privately owned land.

The copper- and iron-mining companies have maintained large holdings partly for subsurface values and partly to guarantee supplies of timber for their underground works. Some of the first purchases were made to obtain wood for the large quantities of charcoal required for smelting in the early days. The depletion of ore reserves and the development of wood preservatives have removed much of the concern for future wood supplies, so that forest management must now stand on its own merits. In general the mining companies' holdings are not being overcut, but as yet there is little evidence of any intention to practice forestry on a permanent basis.

Pulp and paper companies, both Michigan and Wisconsin concerns, have acquired large reserves of spruce and hemlock in the Upper Peninsula. Some are finding it more satisfactory to purchase their wood on the open market or to import it from Canada, however, and there appears to be a tendency to liquidate all but a small supply to be kept for emergencies. Decreased use of wood in automobile manufacture has removed the motor companies' need for large timber reserves, and their holdings are being opened for exploitation.

The timberland holdings of hunting clubs and resorts have been considered unavailable for commercial use, but the need for revenue may eventually force cutting on some of these areas.

Most of the forest land owned by the 10 land companies has been cut over and is being held for speculation. The same is true of the holdings of railroads and individuals. Some of the estates have valuable timber reserves, but with one or two exceptions these are being held for profitable sale rather than permanent management.

Of the private land holdings of less than 2,000 acres each, about one-third (664,000 acres) is woodland within farms, and about two-thirds is in small tracts held more or less speculatively.

Little specific information is available with regard to individual farm holdings. Some are examples of good farm-forest management, as, for example, those of the old-country farmers who have been doing selective logging for years and are getting steady yields of firewood and posts from their woods. In most cases, however, the woodland is merely the uncleared part of the farm. The owner follows the most destructive methods of cutting, and burns and pastures to keep down sprouts and to help clear the land. Often he uses the same methods when he undertakes commercial logging on other lands. Many forties now being logged by small jobbers and farmers are being stripped of all merchantable products, including young saplings, which are cut for chemical wood, posts, or pulp. A large and increasing acreage of this land held by small owners, therefore, is becoming unproductive.

Contributing to the difficulties involved in the problem of timber ownership is the geographic location of individual mills in relation to available timber supplies.

Of the 124 landowners classified in table 15, one-third are timber operators. These operators control 50 percent of the forest acreage and 60 percent of the timber volume, and much the greater part of both is controlled by 26 of them; the remaining 15 own virtually no timber but operate on purchased stumpage or logs purchased from jobbers and farmers. The limited outlook for operators without timber holdings is complicated by uncertainty as to how the timber held by nonoperating companies will be handled, to what extent miscellaneous industries will compete for timber, and how much timber the farmers will cut for such uses as ties and chemical wood. In general, the prospective period of operation of these mills is short.

The 26 operators owning timber reserves apparently control enough stumpage to run at normal production rates for an average period of 16 years. Actually the 4 operators having the least timber acreage will cut out in less than 10 years; and 7 or 8 should be able to operate for 20 years or more.

The outlook for individual mills is far less promising than for the area as a whole. Whereas an average 10- or 15-percent curtailment of production, combined with a program of better management and better utilization, would put the Upper Peninsula on a sustained-yield basis, most of the existing operations would have to reduce production 50 percent or more. The reason lies in the poor integration of mills and timber supplies. Some of the largest mills are in locations where little tributary timber remains, while some of the heaviest timber reserves are in districts not readily accessible to existing mills.

On a selective-logging program, 37 of the 41 operating companies, if they maintained present rates of production, would complete their first cut before any of their timberlands were ready for recutting. To convert the individual operations to a sustained-yield basis, without adding to the timber holdings would require reductions in output of about 25 percent for 4 mills, 50 percent for 12 mills, 75 percent for 4 mills, and the elimination of 21 mills. Thus, even though some of the poorer mills will doubtless pass out of the picture at an early date, the industrial capacity will still exceed the productive capacity of the tributary forest. On the other hand, new mills will be needed in some of the undeveloped districts.

The south-central part of the Peninsula, surrounding Iron Mountain and Menominee, for example, has been largely cut over. The present sawlog requirements of mills at Iron Mountain and Hermansville and of small plants in the area amount to about 85 million board feet annually. At this rate the mills could use all the local timber in 6 or 8 years, with the result that some 4,500 men now employed in them would be left stranded. On a selective-logging and perpetual-yield basis, the local forests would sustain an annual cut of 10 to 14 million feet and afford permanent employment for about 1,100 men. The pulpwood situation is similar; the normal annual drain, 30,000 to 40,000 cords, is more than double the forests' sustained-yield capacity. Local forests would even fall short of supplying perpetually the requirements for chemical wood.

The district surrounding Escanaba, Wells, Gladstone, and Manistique exhibits similar conditions. Local industries normally require about 66 million feet of saw timber per year, whereas sustained-yield management would permit a cut of only 16 million feet a year during the next 25 years. The cut of pulpwood is three times the yield capacity of the forest. If this district were placed on a sustained-yield basis today, employment in woods and mills would be reduced from about 4,200 persons to 1,220.

Sault Ste. Marie has already made its adjustment, and the annual wood requirements of its remaining mills can doubtless be accommodated by the residual timber in the surrounding area.

A number of areas are capable of supporting greater local industrial activity. The district surrounding Marquette, according to survey calculations, could support twice the present normal lumber production if a good system of forest management were adopted. It could go much further than at present in supplying the needs of the local chemical industry and continue to export 18,000 to 20,000 cords of pulpwood. Instead of 850 men as at present, permanent jobs could be given to at least 1,200. Expansion in production of local industries will not be possible, however, if outside industries increase their operations in this territory.

The territory tributary to Munising, with good management, is capable of providing 50 percent more saw timber than local industries now demand. But there is some danger that this margin will be lost through overcutting for pulp and chemical wood.

The greatest undeveloped resources lie in the extreme western end of the Peninsula—in Baraga, Ontonagon, and Gogebic Counties. Here, even with selective logging, production and employment could be maintained at the present level and in some places increased.

Conclusions

THE principal task with which the Forest Survey has been charged is to provide a factual basis upon which regional and national forest policy may be built. This report on forest resources in the Upper Peninsula, however, would not be complete without some conclusions as to what the major objectives of such policy should be.

Present Forestry Practices Unsatisfactory

Neither the rate of cutting, method of cutting, nor the provisions for caring for young growth are at present conducive to maintenance of permanent forest industries in the Upper Peninsula.

Exploitation Too Rapid

The old-growth forests, particularly the pine and northern hardwoods, which provide the foundation for the bulk of the sawmills and miscellaneous wood-using industries are being cut at a rate which will exhaust the loggable stands within 20 years. To bring it into balance with available supplies and current growth, drain on saw timber as a whole would have to be decreased 22 percent, and for the critical species—sugar maple, basswood, and pine—as much as 30 to 40 percent.

Excess sawmill capacity is a part of the problem. In the older logging districts, it is simply out of the question to maintain all of the existing industries on a permanent basis. The sawlog requirements of mills in Menominee and southern Iron County is seven times the sustained-yield capacity of the surrounding timberlands. It would take four times the prospective volume of timber to maintain permanently the mills in the territory surrounding Escanaba and Manistique. A majorty of the large mills in the Sault Ste. Marie territory and the Keweenaw Peninsula have already closed or are operating on the remnants of once large holdings.

In areas accessible to markets, the commonest method of logging is clear-cutting, which means that practically all merchantable products, including cordwood, are removed or destroyed. Frequently the original operation for sawlogs is followed by additional operations for ties, chemical wood, pulpwood, and firewood. Not infrequently, the slashings from these operations are consumed by fire. A clear-cutting operation, when not followed by fire, may leave the land in good condition for restocking, but for most types a period of at least 80 or 100 years must elapse before another crop of merchantable timber can be produced.

Although private owners control 94 percent of the standing saw timber, the total is so widely diffused between individual holdings that few have blocks sufficiently large and well-consolidated to permit permanent management. Few of the operating timberland owners have more than a 10-year supply of standing timber for their mills. Only 7 or 8 in the entire peninsula have enough timber for as long as a 20-year operation, and these holdings are more or less scattered and out of reach of existing mills. The great majority of private timberland owners, judging from current practices, are disposed toward liquidation of investment in standing timber and transfer of cutover lands to public ownership or to farms. Pressure of taxes and other carrying charges, and problems of corporation finance undoubtedly contribute toward adoption of short-term operating policies.

In districts with farming possibilities, the large land companies are primarily interested in disposing of land for agriculture, and will probably not be inclined to encourage reforestation. The same disregard for potential forestry values is maintained by many individual farmers.

The public forests are helping to maintain a few small permanent industries and they promise to contribute still more in the future, but neither State nor Federal forests are sufficiently extensive nor sufficiently well supplied with merchantable timber to exert a major influence in the present situation.

On account of the good market for spruce and jack pine pulpwood, and the steady demand for red and white pine for lumber, piling, mine timbers, etc., there is a tendency to cut these species as soon as they reach minimum merchantable size. Young hardwoods are also being cut on many areas for chemical wood, ties, posts, and fuel. Farmers and small operators on lands close to larger cities are the worst offenders in this respect.

Wastes and Losses Unnecessarily Large

A system of high-grading in which the most valuable species are removed, but large volumes of soft maple, elm, black ash, hemlock, aspen, and paper birch, and cull trees of other species, are left standing, is a rather common method of logging in districts far removed from consuming centers. No part of the Upper Peninsula can be considered wholly inaccessible, but many parts are sufficiently distant from markets or are so lacking in transportation facilities that they present serious marketing problems. The trees left standing in these localities retard the establishment and growth of valuable reproduction and invite the spread of insects and disease.

Accumulations of slash from logging operations and the presence of numerous defective and infested trees on such large areas of land are contributing factors in an annual loss by forest fires and other destructive agencies of 60 million feet of saw timber, and 1½ million cords of other potentially merchantable wood.

Serious fire hazards are created wherever large contiguous blocks of timber are logged by the prevalent clear-cutting or heavy partial-cutting methods. Operators are required by law to take certain precautions to prevent spread of fire, and some go considerably beyond legal requirements in safeguarding operations. Nevertheless, the special hazard which remains for two or three years in hardwoods and up to eight or ten years in some of the softwood types puts an added burden on the State protective organizations which are already fully occupied in bad fire periods.

The 1,204,000 acres of deforested land and 2,082,000 acres of aspen in their present condition are doubtful assets to the Upper Peninsula. The aspen forests are producing large volumes of wood but of such small size and poor quality that only a small fraction can be utilized for commercial purposes. The deforested lands, unless helped by improved fire protection and in part by planting, will remain nonproductive for the rest of the century.

Outlook Unfavorable With Present Trends

Continued clear-cutting of old-growth forests and failure to protect and stimulate regrowth during the next two decades will unquestionably reduce the productivity of the Upper Peninsula forests to the extent that one-half to three-fourths of the present industries will have to close, and the dependent industries in the Lower Peninsula and Wisconsin will suffer proportionately.

With as many as 47,000 employable persons unable to obtain regular work in recent years, and with activity in mining and other industries static or tending to decline, every effort is being made to maintain forestry work at a high level. Unfortunately much of the present work is of a destructive rather than a constructive nature. Liquidation of forest resources will unavoidably add to the unemployment problem 10 to 15 years hence. The eastern counties, and those of the Keweenaw Peninsula, are already feeling the pinch of depleted resources.

Every mill that closes and every tract of timberland logged off and allowed to go tax delinquent adds to the tax burden on remaining property. When it is realized that Upper Peninsula counties are already facing serious difficulties in local finances, and, furthermore, that the bulk of the taxable resources in many townships consists of forest industries and standing timber, the reality of the danger becomes apparent.

Exhaustion of timber resources and decreases in opportunities for part-time work in the woods and mills will have a most adverse effect upon farming, particularly in those districts where full-time commercial agriculture has not proved practicable. Destruction of timber and practices which increase the fire danger are naturally detrimental to the tourist trade. It is not necessary to have vast areas of virgin timber to bring tourists into the district, but a thrifty and growing forest is necessary to maintain the attractiveness of the landscape.

If the remaining timber resources are destroyed, it will require most of another century to restore the forests to a fully productive condition. The most valuable species will not grow from seedling to mature trees in shorter time. Some areas, where soil humus is being depleted by forest fires, will be able to produce only inferior timber for several tree generations.

Situation Not Beyond Repair

In spite of somewhat depleted resources and the undesirable trends noted, the opportunity to maintain the forests in a permanently productive condition is still present in the Upper Peninsula.

The Upper Peninsula has a larger acreage of mature saw timber than any other unit of comparable size in the Lake States. One-fourth of the forest land bears timber of sawlog size. The Upper Peninsula has 40 percent of all the Lake States saw timber and this includes 64 percent of the sugar maple, 69 percent of the hemlock, and 71 percent of the yellow birch. It has about 27 percent of the region's high-grade pulpwood, and 50 percent of the "cedar" poles. Properly managed, this merchantable timber, together with the growth appearing on the cut-over land, will support a large group of industries on a permanent basis.

Under good management, which means proper cutting methods, close utilization of low-grade timber, and careful protection of young growth, the Upper Peninsula forests, as a whole, will yield 589 million board feet annually. This yield can be increased to 650 million board feet in 40 years, and 1,000 million feet eventually.

Ultimate Goal Should Be Sustained-yield Units

The most urgent need in the Upper Peninsula is to stop those practices which destroy existing young growth and prevent natural reforestation. Young growth, which normally should supply the requirements of the region 20 or 30 years hence, is destroyed whenever forests of mixed ages are clear cut. Future yields are impaired whenever thrifty young forests are logged prematurely. Reproduction and young growth is menaced whenever large contiguous blocks of logging slash are allowed to accumulate. Therefore, the first step in any program aimed at permanent forest yields should be to halt these undesirable cutting methods.

Maximum timber yields will be obtained during the next 50 years if a system of light partial cutting is followed in the all-aged northern hardwoods and some of the other forest types. In such cutting, as many as possible of the cull and inferior trees should be removed in the first operation to stimulate the growth of the thrifty trees which are left. Selective logging is not an absolute requirement for good forest management, but it offers the best means of stabilizing timber production without waiting long periods for new growth to mature. It creates lower fire hazards and is less destructive to young growth than clear-cutting.

The aim in forest management should be to create a set of self-sustained management units, covering the principal forest areas of the Peninsula. In these the wood-using industries should be correlated with the growing capacity of the surrounding forest. If completely integrated, no products will be overcut and few will be wasted. This arrangement will not preclude export of logs and bolts, but will eliminate inefficient cross hauls and uncorrelated operations for different products.

What Is Needed

Creation of sustained-yield units will involve some important readjustments in mill production and land ownership. Creation of favorable conditions for such readjustments should be a part of the forestry program for the area.

To bring manufacturing plants into balance with tributary resources, it will be necessary to reduce the output of products made from high-grade maple, basswood, pine, and spruce, particularly in those districts where timber supplies are already badly depleted. This reduction should logically be made by elimination of the least efficient plants rather than pro rata.

At the same time, most localities have a sufficient supply of low-grade wood, including red maple, black ash, cull hardwoods, defective "cedar," shaky hemlock, and undersized aspen, to offer an opportunity for new industries if economic conditions can be made favorable.

From every standpoint, it is desirable to remove more of the cull and weed trees from the forest. Standing, such trees retard growth of other timber and invite spread of insects and disease. Among the possible means of stimulating greater use are (1) improved transportation facilities, (2) more efficient felling, hauling, splitting, and seasoning, (3) a policy of free use to settlers, (4) adaptation of these species to current uses, (5) development of new products. Greater use of these species for chemical wood, pulp, fuel, etc., will promote less drain on maple, basswood, pine, and spruce for these purposes.

The possibilities of using some of the neglected forest products in local handicraft industries should be further explored. Producing tourist souvenirs from paper birch and Christmas decorations from "cedar" and balsam boughs, and boat-building are some that have not been fully developed in local industries.

A sustained-yield management plan will require that the timberlands be in a single ownership or at least managed under a common plan. A few districts are dominated by one or two large owners and consolidation of ownership should not be difficult there. The majority of districts, however, are shared by a number of owners, large and small, each with a separate plan of operation. The solution in these cases is to pool timber holdings and reach an agreement on how much to cut annually.

It may be that private owners will find it difficult to form a timber-holding organization on their own initiative. Few individuals are sufficiently interested to take the initiative. Long-term credit for this type of enterprise is costly and hard to obtain. A few noncooperative owners could easily prevent success. For this reason, a demand has been growing for public aid in promoting sustained-yield units, financing the holding corporation with long-term credit, and purchasing tracts which otherwise will be destructively logged. In some areas complete reversion to public ownership may be the simplest answer.

While the ultimate solution to the unemployment problem in the Upper Peninsula lies in rehabilitating the forests to give a basis for new forest industries, there is need to bridge over a transition period during which employment opportunities will be less than in the recent past.

One possible means of limiting the effect of industrial curtailment is to encourage the trend toward shorter periods of employment and to spread the available jobs more widely. Many of the workers in the Upper Peninsula are adaptable to a mixture of occupations, combining woods or mill work with farming, storekeeping, mining, etc. Perhaps this is the most desirable economic pattern for the immediate future, but it will not carry the employment load adequately without concerted action to stimulate all the available opportunities for employment and to develop part-time farming to carry the people over periods of low industrial activity.

A public-works program aimed at restoring the cut-over forest lands to greater productivity has been pointed to in a recent report of the National Resources Committee as a desirable means of reducing unemployment in the northern Lake States. Several thousand men could readily be given employment during the next 15 or 20 years, protecting the forests from fire, reforesting denuded lands, building woods roads to aid in logging inferior timber.

Public Justified in Acting

Rather large public interests are at stake in the forests of the Upper Peninsula. The public is not only much concerned with the dwindling supply of valuable pine and hardwood timber, but even more so with the threatened decline in employment and local revenue. That public interest may be protected in part, by prohibiting any unwarranted destruction of natural resources; in part, by cooperating with private owners in creating conditions favorable for permanent forest management; and, in part, by public acquisition and direct management of the land. The important consideration is that corrective steps be sufficiently prompt and sufficiently thoroughgoing to prevent the dissipation of the resources upon which much of the future welfare of the district depends.

Appendix

TABLE 16.—*Best, normal, and actual sawmill output and normal associated employment in the Upper Peninsula*

Classification of mills according to normal annual production (M board feet)	Best average annual production [1]	Normal annual production	1934 production		Normal annual employment		Mills reporting
			Actual	In terms of normal	Woods	Mill	
	M bd. ft.	*M bd. ft.*	*M bd. ft.*	*Pct.*	*Man-days*	*Man-days*	*No.*
UPPER PENINSULA							
25,000 and over	88, 000	55, 800	41, 176	73. 8	85, 451	46, 409	2
5,000 to 25,000	434, 938	259, 020	143, 772	55. 5	395, 283	561, 747	23
1,000 to 5,000	60, 356	36, 208	12, 496	34. 5	55, 223	51, 792	17
500 to 1,000	20, 841	13, 742	7, 429	54. 1	20, 927	30, 736	19
50 to 500	22, 281	13, 735	10, 715	78. 0	20, 926	23, 102	89
Less than 50	3, 576	2, 176	1, 517	69. 7	3, 488	4, 471	71
Total	629, 992	380, 681	217, 105	57. 0	581, 298	718, 257	221
EAST HALF							
5,000 to 25,000	202, 770	116, 470	56, 941	48. 9	149, 840	259, 530	12
1,000 to 5,000	21, 794	13, 068	5, 669	43. 4	16, 812	23, 267	7
500 to 1,000	9, 074	6, 680	3, 972	59. 5	8, 594	10, 067	10
50 to 500	11, 761	7, 352	5, 589	76. 0	9, 458	12, 875	46
Less than 50	1, 314	836	528	63. 2	1, 075	1, 989	28
Total	246, 713	144, 406	72, 699	50. 3	185, 779	307, 728	103
WEST HALF							
25,000 and over	88, 000	55, 800	41, 176	73. 8	83, 700	46, 409	2
5,000 to 25,000	232, 168	142, 550	86, 831	60. 9	213, 825	302, 217	11
1,000 to 5,000	38, 562	23, 140	6, 827	29. 5	34, 710	28, 525	10
500 to 1,000	11, 767	7, 062	3, 457	49. 0	10, 593	20, 669	9
50 to 500	10, 520	6, 383	5, 126	80. 3	9, 575	10, 227	43
Less than 50	2, 262	1, 340	989	73. 8	2, 010	2, 482	43
Total	383, 279	236, 275	144, 406	61. 1	354, 413	410, 529	118

[1] Based on best three years in decade, 1924–33.

TABLE 17.—*Area of forest land in the Upper Peninsula by forest-cover type and size class, 1935*

TABLE 17.—*Area of forest land in the Upper Peninsula by forest-cover type and size class, 1935*—Continued

Forest-cover type	Saw timber [1]		Cordwood [1]	Restocking in density—		All size classes
	Old growth	Second growth		Fair to good	Poor	
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
White pine	43	28	32	8	9	120
Red pine	3	11	24	1	11	50
Jack pine		2	61	57	113	233
Spruce-fir	48	167	404	277	239	1, 135
Spruce swamp	3	26	132	148	120	429
Tamarack swamp		6	46	65	56	173
"Cedar" swamp	16	53	121	186	70	446
Northern hardwoods	1, 510	368	314	656	374	3, 222
Ash-elm	23	39	68	30	40	200
Aspen-birch	12	54	523	695	798	2, 082
Scrub forest			2	4	16	22
Nonproductive swamp				7	13	[2] 20
Deforested						1, 204
Total	1, 658	754	1, 727	2, 134	1, 859	9, 336
Percentage	17. 8	8. 1	18. 5	22. 8	19. 9	[2] 100

See footnote at end of table.

[1] Old-growth saw timber includes the 16-inch (15.1+ inches d. b. h.) diameter class and higher; second growth comprises the 10-, 12-, and 14-inch classes; cordwood, the 4-, 6-, and 8-inch classes.

[2] Deforested area amounts to 12.9 percent of all size classes and all cover types.

TABLE 18.—*Density of timber stands* [1] *in the Upper Peninsula, by forest-cover type and size class, 1935*

Forest-cover type	Old-growth saw timber			Second-growth saw timber		
	Good	Medium	Poor	Good	Medium	Poor
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
White pine	32. 6	34. 9	32. 5		25. 0	75. 0
Red pine			100. 0			100. 0
Jack pine					50. 0	50. 0
Spruce-fir	25. 0	52. 1	22. 9	7. 8	37. 1	55. 1
Spruce swamp	33. 4	33. 3	33. 3	3. 8	23. 1	73. 1
Tamarack swamp					16. 7	83. 3
"Cedar" swamp	62. 5	25. 0	12. 5	18. 9	43. 4	37. 7
Northern hardwoods	65. 3	23. 9	10. 8	8. 2	34. 2	57. 6
Ash-elm	17. 4	34. 8	47. 8	7. 7	33. 3	59. 0
Aspen-birch	16. 7	41. 6	41. 7	5. 6	22. 2	72. 2
Total	62. 0	25. 3	12. 7	8. 0	33. 3	58. 7

[1] In the case of saw-timber stands, areas containing 10 thousand board feet per acre or more were classified as good stocking; from 5 to 10 thousand as medium, and from 2 to 5 as poor.

In cordwood, areas with 12.5 cords per acre or more were considered well stocked; from 7.5 to 12.5 cords as medium, and from 3 to 7.5 as poor.

On restocking areas, land on which seedlings or saplings occupied 70 percent or more of the area was designated as well stocked; from 40 to 70 as medium, and from 10 to 40 as poor. With less than 10 percent of the area occupied, the land was called deforested.

TABLE 18.—*Density of timber stands in the Upper Peninsula, by forest-cover type and size class, 1935*—Continued

Forest-cover type	Cordwood			Restocking		
	Good	Medium	Poor	Good	Medium	Poor
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
White pine	9.4	25.0	65.6	23.5	23.5	53.0
Red pine	20.8	25.0	54.2		8.3	91.7
Jack pine	11.5	32.8	55.7	8.2	25.3	66.5
Spruce-fir	17.1	35.1	47.8	27.3	26.4	46.3
Spruce swamp	19.7	38.6	41.7	23.1	32.1	44.8
Tamarack swamp	4.3	26.1	69.6	23.1	30.6	46.3
"Cedar" swamp	18.2	44.6	37.2	44.1	28.5	27.4
Northern hardwoods	8.3	23.6	68.1	37.1	26.6	36.3
Ash-elm	7.4	38.2	54.4	20.0	22.9	57.1
Aspen-birch	10.9	32.5	56.6	19.4	27.1	53.5
Scrub forest			100.0		20.0	80.0
Nonproductive swamp				5.0	30.0	65.0
Total	12.9	32.6	54.5	26.3	27.2	46.5

TABLE 19.—*Average volume of timber per acre, by forest-cover type and size class of stand, Upper Peninsula, 1935*

SAW-TIMBER VOLUME[1]

Forest-cover type	Saw-timber stands		Cordwood stands	Restocking stands[2]
	Old growth	Second growth		
	Bd. ft.	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
White pine	8,270	3,880	970	210
Red pine	3,200	2,540	620	50
Jack pine		3,100	520	50
Spruce-fir	5,810	3,970	960	270
Spruce swamp	6,640	3,540	640	50
Tamarack swamp		2,630	370	30
"Cedar" swamp	2,930	2,130	580	130
Northern hardwoods	11,400	4,300	910	480
Ash-elm	6,520	4,080	850	310
Aspen-birch	7,140	3,840	510	60
Scrub forest			700	0
Nonproductive swamp				0
Average all types	10,950	3,950	720	200

PULPWOOD

	Cords	*Cords*	*Cords*	*Cords*
White pine	2.7	2.3	1.3	0.1
Red pine	2.0	1.0	1.4	.1
Jack pine		6.7	4.7	.3
Spruce-fir	3.0	4.8	4.1	.7
Spruce swamp	4.1	6.0	5.9	.5
Tamarack swamp		6.4	4.2	.4
"Cedar" swamp	2.1	3.1	2.5	.7
Northern hardwoods	1.5	1.7	.8	.2
Ash-elm	.9	1.4	1.0	.3
Aspen-birch	3.5	4.1	2.4	.1
Scrub forest			.5	.0
Nonproductive swamp				.2
Average all types	1.6	2.9	2.8	.3

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[1] International ¼-inch scale.

[2] Stands with 100 or more well-spaced small trees per acre.

TABLE 19.—*Average volume of timber per acre, by forest-cover type and size class of stand, Upper Peninsula, 1935*—Contd.

TOTAL VOLUME

Forest-cover type	Saw-timber stands		Cordwood stands	Restocking stands[2]
	Old growth	Second growth		
	Cubic feet	*Cubic feet*	*Cubic feet*	*Cubic feet*
White pine	2,395	1,393	688	118
Red pine	1,000	909	708	37
Jack pine		1,500	557	47
Spruce-fir	2,458	1,796	861	225
Spruce swamp	2,333	1,577	742	75
Tamarack swamp		1,000	478	66
"Cedar" swamp	3,125	2,377	1,000	258
Northern hardwoods	3,242	1,704	694	239
Ash-elm	2,261	1,974	765	214
Aspen-birch	2,333	1,556	623	46
Scrub forest			488	31
Nonproductive swamp				16
Average all types	3,170	1,741	729	138

TABLE 20.—*Volume of merchantable timber in the Upper Peninsula, 1935*

SAWLOG VOLUME

Species	By International ¼-inch log rule	By Scribner log rule	Cubic equivalent
Softwoods:	*Million board feet*	*Million board feet*	*Million cubic feet*
White pine	813	713	129
Red pine	84	67	15
Jack pine	55	45	10
Spruces	959	794	166
Balsam fir	569	470	100
Tamarack	56	46	11
Hemlock	6,362	5,635	984
Total	8,898	7,770	1,415
Hardwoods:			
Sugar maple	6,733	5,950	1,047
Yellow birch	3,725	3,285	582
Basswood	451	398	70
Elm	437	385	69
Beech	964	854	150
Oaks	64	53	11
Aspen	551	446	97
Paper birch	292	236	51
Soft maples	843	745	132
Miscellaneous	326	286	51
Total	14,386	12,638	2,260
All species	23,284	20,408	3,675

TABLE 20.—*Volume of merchantable timber in the Upper Peninsula, 1935*—Continued

CORDWOOD AND TOTAL VOLUME

Species	Volume in cords	Cubic equivalent	Total volume
Softwoods:	*1,000 cords*	*Million cubic feet*	*Million cubic feet*
White pine	934	70	199
Red pine	240	18	33
Jack pine	480	36	46
Spruces	3, 066	230	396
Balsam fir	4, 373	328	428
Tamarack	413	31	42
Hemlock	9, 067	680	1, 664
White-cedar	8, 133	610	610
Total	26, 706	2, 003	3, 418
Hardwoods:			
Sugar maple	13, 734	1, 030	2, 077
Yellow birch	7, 680	576	1, 158
Basswood	933	70	140
Elm	773	58	127
Beech	1, 840	138	288
Oaks	214	16	27
Aspen	4, 346	326	423
Paper birch	1, 867	140	191
Soft maples	3, 560	267	399
Miscellaneous	1, 680	126	177
Total	36, 627	2, 747	5, 007
All species	[1] 75, 653	[1] 5, 674	[1] 9, 349

[1] Includes 12,320,000 cords (924 million cubic feet) of cull trees.

TABLE 21.—*Volume of saw timber in the Upper Peninsula by species, kind of stand, and tree size, 1935*

Species	Saw-timber stands by d. b. h. classes—		Cordwood and restocking stands by d. b. h. classes—		Total volume
	10 to 12 inches	14 inches or higher	10 to 12 inches	14 inches or higher	
Softwoods:	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*
White pine	51	621	59	82	813
Red pine	8	26	26	24	84
Jack pine	4	5	36	10	55
Spruces	288	435	177	59	959
Balsam fir	301	110	138	20	569
Tamarack	14	3	29	10	56
Hemlock	440	5, 783	59	80	6, 362
Total	1, 106	6, 983	524	285	8, 898
Hardwoods:					
Sugar maple	624	5, 746	130	233	6, 733
Yellow birch	275	3, 159	82	209	3, 725
Basswood	29	389	16	17	451
Elm	25	376	13	23	437
Beech	205	727	18	14	964
Oaks	5	28	10	21	64
Aspen	127	139	225	60	551
Paper birch	52	95	88	57	292
Soft maples	150	624	31	38	843
Miscellaneous	72	201	33	20	326
Total	1, 564	11, 484	646	692	14, 386
All species	2, 670	18, 467	1, 170	977	23, 284
Percentage	11. 5	79. 3	5. 0	4. 2	100

TABLE 22.—*Average quality of hardwood saw timber, Upper Peninsula, 1935*

WEST HALF

Species	Distribution of net board-foot volume by sawlog grade		
	Grade I	Grade II	Grade III
	Percent	*Percent*	*Percent*
Sugar maple	32	41	27
Yellow birch	42	37	21
Basswood	54	30	16
Elm	37	47	16
Beech	22	54	24
Oaks	30	36	34
Aspen	5	31	64
Paper birch	13	51	36
Soft maples	12	49	39
Miscellaneous hardwoods	15	42	43
Total	34	40	26

EAST HALF

Species	Grade I	Grade II	Grade III
Sugar maple	27	56	17
Yellow birch	31	52	17
Basswood	49	34	17
Elm	35	47	18
Beech	20	55	25
Oaks	27	42	31
Aspen	8	32	60
Paper birch	11	50	39
Soft maples	11	49	40
Miscellaneous hardwoods	15	43	42
Total	24	52	24

TABLE 23.—*Current annual growth per acre in the Upper Peninsula, by forest-cover type and size class of stand*

BOARD FOOT MEASURE

Forest-cover type	Old-growth saw timber	Second-growth saw timber	Cordwood	Restocking	All classes
White pine	71	152	90	43	91
Red pine	21	65	76	4	53
Jack pine		63	64	9	23
Spruce-fir	36	59	59	16	38
Spruce swamp	23	51	58	5	24
Tamarack swamp		50	41	4	16
"Cedar" swamp	5	13	8	9	9
Nonproductive swamp				0	0
Northern hardwoods	75	95	56	24	59
Ash-elm	67	102	83	29	66
Aspen-birch	0	226	65	5	26
Scrub forest			53	3	7
Deforested					4
Average all types	72	91	58	12	37

TABLE 23.—*Current annual growth per acre in the Upper Peninsula, by forest-covered type and size class of stand*—Continued

CUBIC-FOOT MEASURE

Forest-cover type	Old-growth saw timber	Second-growth saw timber	Cord-wood	Re-stocking	All classes
White pine	7	18	38	29	21
Red pine	2	7	30	5	17
Jack pine	--------	4	16	5	8
Spruce-fir	6	8	15	19	15
Spruce swamp	1	5	19	10	12
Tamarack swamp	--------	4	14	9	11
"Cedar" swamp	4	3	3	16	14
Nonproductive swamp	--------	--------	--------	5	5
Northern hardwoods	14	18	25	29	21
Ash-elms	10	17	23	13	17
Aspen-birch	0	28	53	16	26
Scrub forest	--------	--------	25	8	9
Deforested	--------	--------	--------	--------	2
Average all types	13	15	29	19	18

TABLE 24.—*Normal annual increment,*[1] *Upper Peninsula*

SAW-TIMBER INCREMENT

Species	Old-growth stands	Second-growth stands	Cord-wood stands	Re-stocking and de-forested	Stands of all size classes
	M board feet	*M board feet*	*M board feet*	*M board feet*	*M board feet*
White pine	3, 900	7, 200	7, 900	5, 700	24, 700
Red pine	0	600	2, 700	1, 600	4, 900
Jack pine	0	100	2, 800	2, 000	4, 900
Spruces	1, 700	5, 600	10, 600	2, 400	20, 300
Balsam fir	1, 200	2, 800	5, 200	1, 900	11, 100
Tamarack	0	300	2, 400	1, 400	4, 100
Hemlock	37, 600	6, 100	2, 800	3, 300	49, 800
Sugar maple	37, 500	10, 400	10, 400	11, 400	69, 700
Yellow birch	19, 000	8, 800	12, 100	7, 600	47, 500
Basswood	2, 500	400	1, 200	900	5, 000
Elm	3, 600	1, 000	900	1, 500	7, 000
Beech	5, 700	2, 100	1, 400	1, 000	10, 200
Oaks	100	800	5, 200	1, 500	7, 600
Aspen	0	10, 800	22, 100	3, 300	36, 200
Paper birch	0	5, 300	8, 100	3, 500	16, 900
Soft maples	6, 100	3, 800	2, 700	3, 200	15, 800
Miscellaneous hardwoods	1, 400	2, 700	1, 800	1, 900	7, 800
Total	120, 300	68, 800	100, 300	54, 100	343, 500

TABLE 24.—*Normal annual increment, Upper Peninsula*—Continued

TOTAL INCREMENT

Species	Old-growth stands	Second-growth stands	Cord-wood stands	Re-stocking and de-forested	Stands of all size classes
	M cubic feet	*M cubic feet*	*M cubic feet*	*M cubic feet*	*M cubic feet*
White pine	300	600	2, 500	2, 200	5, 600
Red pine	0	0	800	800	1, 600
Jack pine	0	0	900	900	1, 800
Spruces	200	900	3, 500	3, 300	7, 900
Balsam fir	300	700	2, 500	3, 000	6, 500
Tamarack	0	0	800	1, 300	2, 100
Hemlock	6, 400	1, 100	1, 200	4, 400	13, 100
"Cedar"	200	200	600	4, 200	5, 200
Sugar maple	7, 400	2, 000	2, 600	13, 200	25, 200
Yellow birch	3, 800	1, 600	2, 300	7, 100	14, 800
Basswood	500	100	300	1, 000	1, 900
Elm	400	200	400	600	1, 600
Beech	1, 100	400	200	900	2, 600
Oaks	0	100	600	1, 400	2, 100
Aspen	0	1, 400	21, 600	19, 900	42, 900
Paper birch	0	700	8, 300	9, 300	18, 300
Soft maples	1, 000	600	1, 500	1, 700	4, 800
Miscellaneous hardwoods	300	400	1, 000	1, 200	2, 900
Total	21, 900	11, 000	51, 600	76, 400	160, 900

TABLE 25.—*Allowable drain, Upper Peninsula, by species and kind of material*

Species	Saw timber	Additional cordwood	Total volume
Softwoods:	*M bd. ft.*	*Cords*	*M cu. ft.*
White pine	21, 100	20, 000	4, 800
Red pine	1, 600	1, 000	400
Jack pine	1, 200	1, 000	300
Spruces	22, 200	39, 000	6, 700
Balsam fir	10, 200	40, 000	4, 800
Tamarack	3, 500	7, 000	1, 100
Hemlock	168, 300	158, 000	37, 700
"Cedar"	--------	--------	4, 500
Total	228, 100	266, 000	60, 300
Hardwoods:			
Sugar maple	142, 300	197, 000	36, 700
Yellow birch	105, 300	146, 000	27, 300
Basswood	15, 200	22, 000	3, 900
Elm	9, 900	14, 000	2, 500
Beech	15, 000	20, 000	3, 700
Oaks	2, 400	7, 000	900
Aspen	28, 300	268, 000	25, 000
Paper birch	10, 900	138, 000	12, 200
Soft maples	24, 000	33, 000	6, 200
Miscellaneous	7, 500	12, 000	2, 100
Total	360, 800	857, 000	120, 500
All species	588, 900	1, 123, 000	180, 800

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[1] Estimated normal for 10 years, 1940–49.

TABLE 26.—*Annual drain on forests of the Upper Peninsula of Michigan—estimated normal for period 1940–49*

Item	Merchantable trees: Total volume	Merchantable trees: Sawlog volume	Merchantable trees: Cord-wood volume	"Unmerchantable" trees and salvage
Cutting:	*1,000 cubic feet*	*1,000 board feet*	*Cords*	*Cords*
Lumber [1]	60, 750	391. 600	1, 200	1, 700
Pulpwood [2]	37, 650	102, 900	274, 200	21, 500
Fuel wood	23, 000	27, 300	244, 200	403, 800
Distillation wood	11, 170	33, 250	80, 600	77, 000
Mine timbers	7, 280	38, 300	11, 600	27, 900
Wood product logs [3]	4, 650	29, 900	400	----------
Fence posts	4, 460	----------	59, 500	300
Poles and piling	2, 740	600	35, 200	100
Veneer logs	1, 940	12, 600	----------	----------
Hewed ties	1, 710	7, 750	6, 800	
Container logs [4]	1, 510	9, 800	----------	----------
Miscellaneous [5]	1, 800	3, 700	15, 600	8, 700
Subtotal	159, 570	657, 700	729, 300	541, 000
Logging waste	61, 330	30, 800	753, 500	----------
Total cutting	219, 900	688, 500	1, 482, 800	541, 000
Fire	6, 200	11, 700	58, 000	----------
Wind, insects, disease, etc	21, 100	58, 200	158. 000	----------
Total drain	247, 200	758, 400	1, 698, 800	----------

[1] Includes sawed ties and logs shipped out of the Upper Peninsula for sawing elsewhere.

[2] About two-thirds of this pulpwood is shipped out of the Upper Peninsula.

[3] Logs for bowls and miscellaneous items.

[4] Logs used for making barrels, cheese boxes, baskets, etc.

[5] Lath, shingles, and excelsior bolts; cabin logs and miscellaneous rough products.

TABLE 27.—*Normal annual drain on the forests of the Upper Peninsula, by species, 1940–49*

Species	Drain on merchantable trees: Saw timber	Drain on merchantable trees: Cord-wood [1]	Drain on merchantable trees: Total volume	Cut from unmerchantable material
Softwoods:	*M board feet*	*Cords*	*M cubic feet*	*Cords*
White pine	28, 000	40, 700	7, 400	14, 200
Red pine	3, 200	4, 400	900	900
Jack pine	9, 500	40, 600	4, 600	1, 600
Spruces	65, 300	173, 700	24, 200	15, 300
Balsam fir	26, 800	122, 000	13, 700	3. 200
Tamarack	9, 500	11, 900	2, 600	33, 000
Hemlock	149, 400	211, 800	39, 000	67, 700
"Cedar"	----------	----------	15, 500	5, 900
Total	291, 700	605, 100	107, 900	141, 800
Hardwoods:				
Sugar maple	246, 400	407, 400	68, 700	190, 400
Yellow birch	111, 700	182, 000	31, 000	102, 400
Basswood	22, 800	37, 700	6, 300	8, 500
Elm	26, 500	42, 100	7, 300	11, 500
Beech	19, 800	36, 700	5, 800	18, 800
Oaks	1, 900	6, 400	800	500
Aspen	14, 500	79, 500	8, 500	22, 800
Paper birch	8, 400	35, 900	4, 100	7, 500
Soft maples	10, 700	44, 800	5, 100	35, 700
Miscellaneous	4, 000	14, 500	1, 700	1, 100
Total	466, 700	887, 000	139, 300	399, 200
All species	758, 400	1, 492, 100	247, 200	541, 000

[1] Small trees, tops and limbs of saw-timber trees, and cull portions of saw-timber trees.

TABLE 28.—*Stand, increment, and allowable and actual drain, in the Upper Peninsula*

SAW-TIMBER VOLUME (MILLION BOARD FEET)

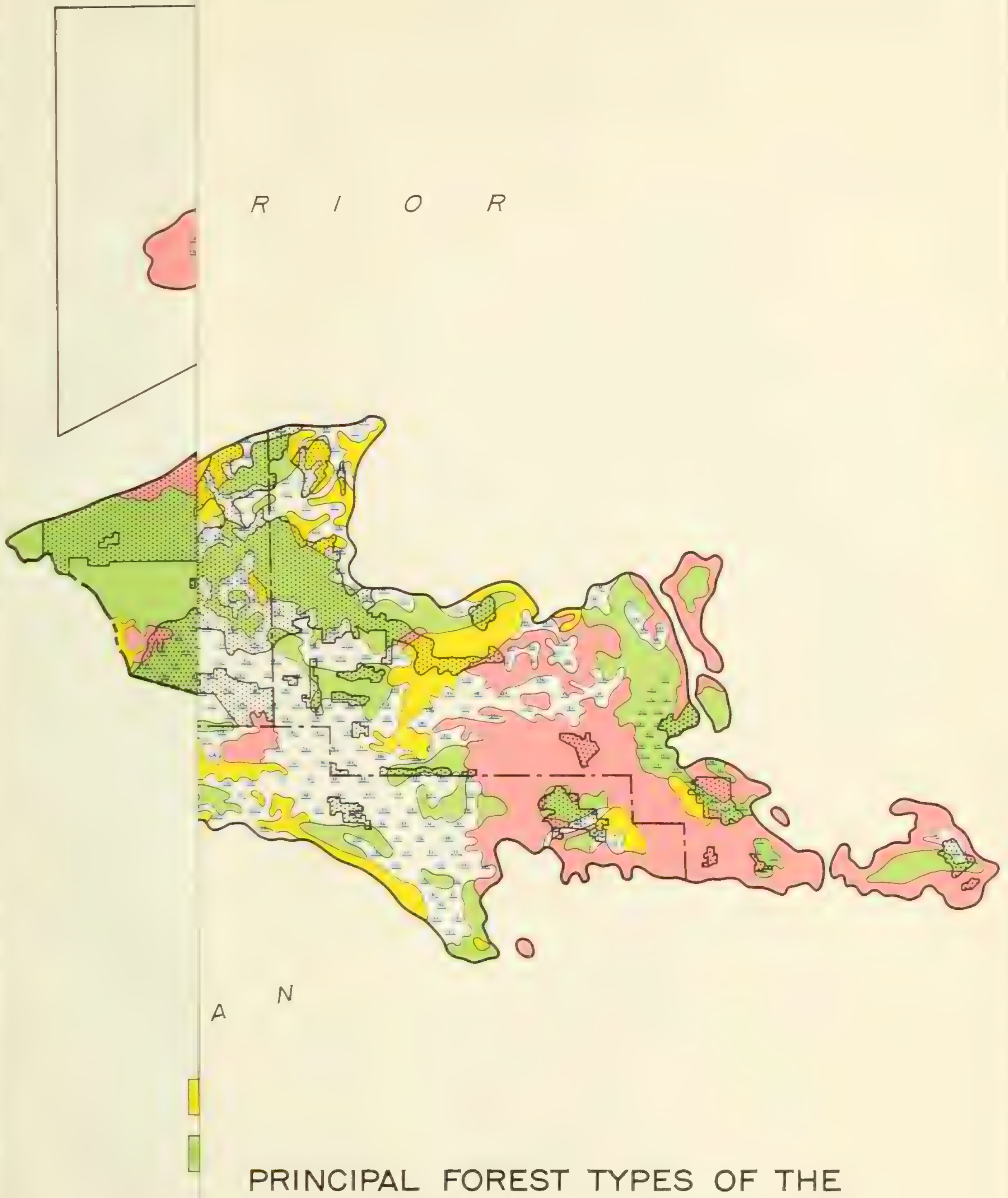
Species	Total present stand	Annual increment	Allowable drain	Actual drain
Softwoods:				
White pine	813	24. 7	21. 1	28. 0
Red pine	84	4. 9	1. 6	3. 2
Jack pine	55	4. 9	1. 2	9. 5
Spruces	959	20. 3	22. 2	65. 3
Balsam fir	569	11. 1	10. 2	26. 8
Tamarack	56	4. 1	3. 5	9. 5
Hemlock	6, 362	49. 8	168. 3	149. 4
Total	8, 898	119. 8	228. 1	291. 7
Hardwoods:				
Sugar maple	6, 733	69. 7	142. 3	246. 4
Yellow birch	3, 725	47. 5	105. 3	111. 7
Basswood	451	5. 0	15. 2	22. 8
Elm	437	7. 0	9. 9	26. 5
Beech	964	10. 2	15. 0	19. 8
Oaks	64	7. 6	2. 4	1. 9
Aspen	551	36. 2	28. 3	14. 5
Paper birch	292	16. 9	10. 9	8. 4
Soft maples	843	15. 8	24. 0	10. 7
Miscellaneous	326	7. 8	7. 5	4. 0
Total	14, 386	223. 7	360. 8	466. 7
All species	23, 284	343. 5	588. 9	758. 4

TOTAL VOLUME (MILLION CUBIC FEET)

Species	Total present stand	Annual increment	Allowable drain	Actual drain
Softwoods:				
White pine	199	5. 6	4. 8	7. 4
Red pine	33	1. 6	. 4	. 9
Jack pine	46	1. 8	. 3	4. 6
Spruces	396	7. 9	6. 7	24. 2
Balsam fir	428	6. 5	4. 8	13. 7
Tamarack	42	2. 1	1. 1	2. 6
Hemlock	1, 664	13. 1	37. 7	39. 0
White-cedar	610	5. 2	4. 5	15. 5
Total	3, 418	43. 8	60. 3	107. 9
Hardwoods:				
Sugar maple	2, 077	25. 2	36. 7	68. 7
Yellow birch	1, 158	14. 8	27. 3	31. 0
Basswood	140	1. 9	3. 9	6. 3
Elm	127	1. 6	2. 5	7. 3
Beech	288	2. 6	3. 7	5. 8
Oaks	27	2. 1	. 9	. 8
Aspen	423	42. 9	25. 0	8. 5
Paper birch	191	18. 3	12. 2	4. 1
Soft maples	399	4. 8	6. 2	5. 1
Miscellaneous	177	2. 9	2. 1	1. 7
Total	5. 007	117. 1	120. 5	139. 3
All species	8, 425	160. 9	180. 8	247. 2

TABLE 29.—*Estimate of changes in inventory during period 1935–40*

Species	Volume, 1935		Net depletion or accretion, 1935–40		Estimated volume, 1940	
	Saw timber	Total	Saw timber	Total	Saw timber	Total
	Million bd. ft.	*Million cu. ft.*	*Million bd. ft*	*Million cu. ft.*	*Million bd. ft.*	*Million cu. ft.*
Softwoods:						
White pine	813	199	−16	−9	797	190
Red pine	84	33	+8	+3	92	36
Jack pine	55	46	−23	−14	32	32
Spruces	959	396	−225	−81	734	315
Balsam fir	569	428	−78	−34	491	394
Tamarack	56	42	−27	−2	29	40
Hemlock	6,362	1,664	−537	−130	5,825	1,534
"Cedar"		610		−51		559
Total	8,898	3,418	−898	−318	8,000	3,100
Hardwoods:						
Sugar maple	6,733	2,077	−883	−218	5,850	1,859
Yellow birch	3,725	1,158	−321	−81	3,404	1,077
Basswood	451	140	−89	−22	362	118
Elm	437	127	−98	−28	339	99
Beech	964	288	−48	−16	916	272
Oaks	64	27	+28	+6	92	33
Aspen	551	423	+138	+172	689	595
Paper birch	292	191	+42	+71	334	262
Soft maples	843	399	+26	−1	869	398
Miscellaneous	326	177	+19	+10	345	187
Total	14,386	5,007	−1,186	−107	13,200	4,900
All species	23,284	8,425	−2,084	−425	21,200	8,000



PRINCIPAL FOREST TYPES OF THE
UPPER PENINSULA OF MICHIGAN
ORIGINAL AND PRESENT AREAS

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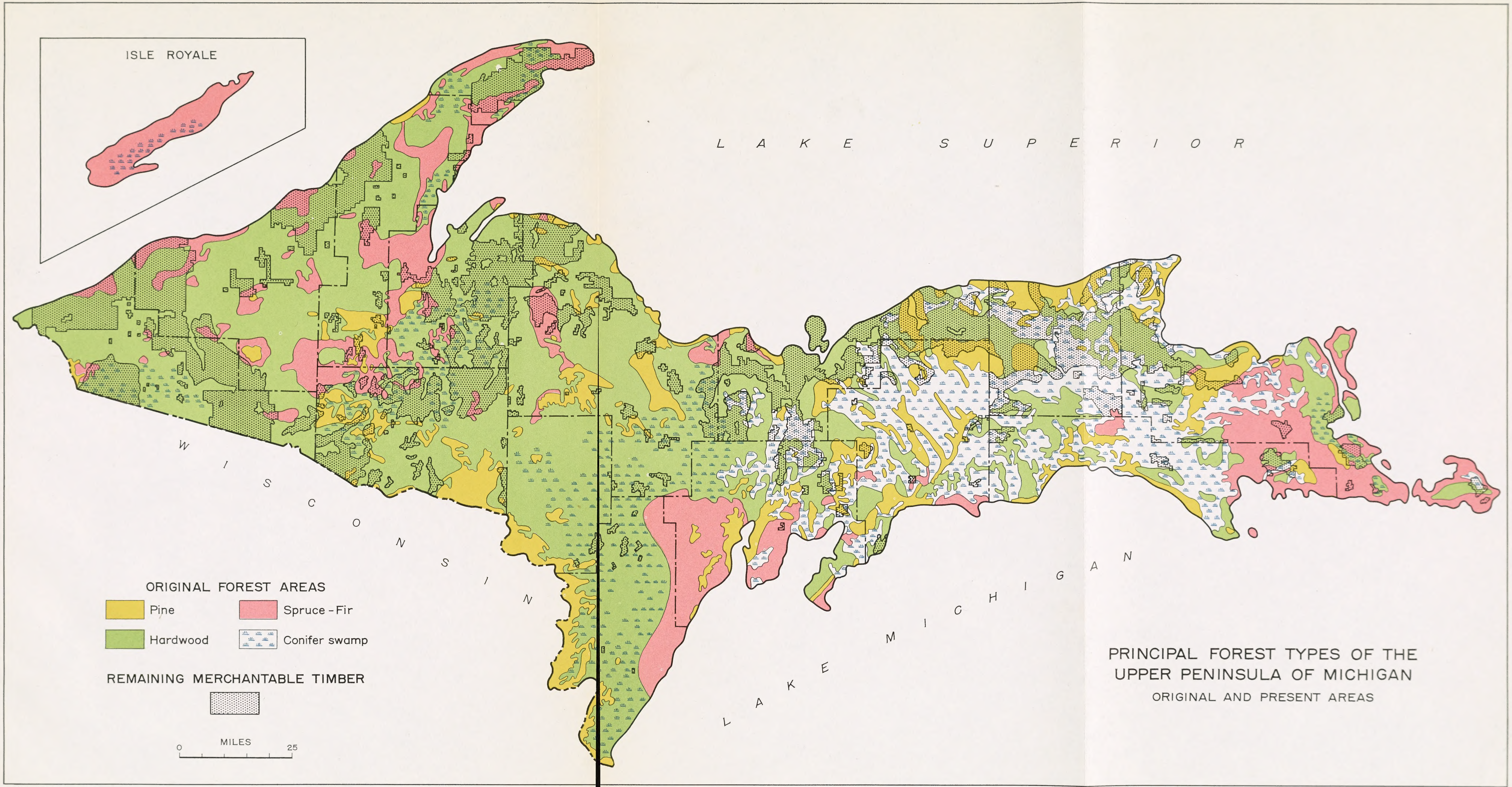

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